ABSTRACT BOOK
SETAC Europe 28th Annual Meeting

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This book compiles the abstracts from the platform and poster session presentations at the 28th Annual Meeting of the Society of Environmental Toxicology and Chemistry- Europe (SETAC Europe), conducted at the Rome Convention Centre La Nuvola, Rome, Italy, from 13 – 17 May 2018.
The abstracts are reproduced as submitted by the author and accepted by the Scientific Committee. They appear in order of abstract code and alphabetical order per presentation type. The poster spotlight abstracts are included in the list of poster abstracts. The presenting author of each abstract is underlined.

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SOCIETY OF ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY
In the 1970s, no forum existed for interdisciplinary communication among environmental scientists, biologists, chemists, toxicologists, managers, engineers or others interested in environmental issues. The Society of Environmental Toxicology and Chemistry (SETAC) was founded in North America in 1979 to fill the void, and quickly saw dynamic growth in the Society's membership, meeting attendance and publications.

A unique strength of SETAC is its commitment to balance the scientific interests of government, academia and business. The Society by-laws mandate equal representation from these three sectors for officers of the World Council and Geographic Unit Boards of Directors and Councils, and in the composition of committees and other society activities. The proportion of members from each of the three sectors has remained nearly equal over the years.

The Society is concerned about global environmental issues. Its members are committed to Environmental Quality Through Science®, to timely and effective communication of
research, and to interactions among professionals so that enhanced knowledge and increased personal exchanges occur. Therefore, SETAC publishes two globally esteemed scientific journals and convenes annual meetings around the world, showcasing cutting-edge science in poster and platform presentations. Because of its multidisciplinary approach, the scope of the science of SETAC is broader in concept and application than that of many other societies.

SETAC’s growth is reflected in the founding of geographic units around the world. SETAC Europe was established in 1989 as an independent organisation, followed by SETAC Asia-Pacific in 1997 and SETAC Latin America in 1999. In 2002, the four existing organisations joined together under the governance of the SETAC World Council. SETAC Africa is the most recent geographic unit, which was adopted in 2012. As evidence of international acceptance of the SETAC model and of the great interest at the local level, regional chapters and branches have emerged in a number of countries.

SETAC publishes two journals: *Environmental Toxicology and Chemistry* (ET&C) and *Integrated Environmental Assessment and Management* (IEAM). Environmental Toxicology and Chemistry is dedicated to furthering scientific knowledge and disseminating information on environmental toxicology and chemistry, including the application of these sciences to risk assessment. Integrated Environmental Assessment and Management focuses on the application of science in environmental decision-making, regulation, and management, including aspects of policy and law, and the development of scientifically sound approaches to environmental problem solving. Together, these journals provide a forum for professionals in academia, business, government, and other segments of society involved in the use, protection, and management of the environment for the enhancement of ecological health and human welfare.

SETAC books provide timely in-depth reviews and critical appraisals on scientific subjects relevant to understanding a wide range of contemporary topics pertaining to the environment. These include any aspect of environmental chemistry, toxicology, risk assessment, risk management, or environmental policy.

SETAC has two administrative offices, in Pensacola, Florida, USA, established in 1992, and in Brussels, Belgium, established in 1993.
Keynote abstracts

Keynote Sunday
Responsible Research and Innovation (RRI) - a Path towards Sustainability?
Bernhard Url, EFSA, Italy
EFSA provides independent scientific advice on all matters related with food and feed with a direct or indirect impact on human, plant and animal health. EFSA takes into account environmental risk assessment in its assessments of the application of plant protection products, the deliberate release into the environment of GMOs and the use of certain substances in food and feed (e.g. feed additives). EFSA also assesses the environmental risks related to the entry and spread of invasive alien species harmful for plant health. EFSA is looking into the future, keeping up with a rapidly evolving and globalised world, characterised by dramatic environmental and other global changes (e.g. economic, political social, and technological) and an exponential growth and availability of data. These set new opportunities and challenges to the assessment of risks to both the environment and food safety and can drive their (re)emergence. In this context, EFSA is reviewing the methodologies for risk assessment and for the identification of emerging risks within its remit.

Predictive modelling tools based on holistic approaches for environmental risk assessment in realistic landscapes and under different scenarios of multiple stressors are being developed. Approaches considering the complex interactions and dynamics between the different food system actors, their behaviour and external drivers are proposed as tools useful for long term anticipation of emerging risks. Expert knowledge elicitation, horizon scanning, and crowdsourcing are being explored as tools to broaden participation, strengthen engagement of all relevant stakeholders and manage interconnectivity, in application of principles of resilience thinking.

Environmental quality and food safety are strongly intertwined. They need to be considered together when aiming toward the achievement of sustainable development goals. Consistent approaches for scientific assessment and data management need to be developed, integrating also societal, technological and economic drivers to effectively cope with the dramatic global changes and the data revolution we are observing.

Keynote Tuesday
Innovative Research Issues in Environmental Mutagenesis
Eugenia Dogliotti, Istituto Superiore di Sanità, Department of Environment and Health, Italy
During the 1920s, mutation research was put on a firm basis by H. J. Muller, who developed the concept of “mutation rate” and devised quantitative techniques for its measurement. These techniques allowed the discovery of the mutagenic action of ionizing radiation and paved the way for the pioneering work of C. Auerbach on chemical testing, starting with mustard gas. Since that time the recognition of the multitude of possible sources of mutagenic insults promoted the development of the science of environmental mutagenesis. Today the mechanisms by which chemicals induce mutation and the role of genetic susceptibility in the response to environmental mutagens have been largely explored. Moreover, a battery of test methods is available for regulatory purposes. What are the current challenges in environmental mutagenesis? New techniques for mutation research have been developed. The “omics” technologies such as whole genome sequencing, epigenetic profiling, transcriptomics, proteomics and metabolomics have provided a snapshot of the effects of genetic polymorphisms, gene regulation, protein synthesis and stability, metabolic pathways in the control of cell function. This presentation will describe: 1) the successful identification of the mutagenic environmental agents underlying certain types of cancer by using whole genome sequencing; ii) the evidence that epigenetic alterations mediate toxicity from environmental chemicals and, iii) the use of the exposome approach, that comprises all environmental exposures that a person experiences from conception throughout the life course, to unravel complex gene environment interactions that affect disease risk.

Keynote Wednesday
The Environmental Dimension of Antimicrobial Resistance: Assessing and Managing the Risks of Anti-infectives
Jason Snape, AstraZeneca Global Safety, Health and Environment, UK
Antibiotics are vital in the treatment of infectious disease in both livestock and human and they are entering the environment continuously. In freshwaters antibiotics can reach concentrations up to mg/L, but more commonly they occur in the low to sub μg/L range. They selectively target bacteria and thus there is an increased likelihood for impacts on environmental bacteria populations at levels well below that for effects on aquatic vertebrates. However, current environmental risk assessment (ERA) frameworks of antibiotics, as required by the European Medicines Agency guidelines 2006, adopts the use of one species of cyanobacteria only to represent all bacterial diversity. The activated sludge respiration inhibition test (ASRIT), used to identify risk to microorganisms in sewage treatment plants has also been proven to be insensitive for antibiotics. Thus, there is concern that the ERA for antibiotics does not fully consider their potential impacts on microbial community structure, function and resilience. In addition to the risk posed to ecosystem function there is a global concern on antimicrobial resistance (AMR) development and the associated risk to human health. It has been proposed that the risk of AMR development in the natural environment should be included in ERA but there is currently no standard experimental methodology or framework to address this. Recently, a theoretical approach that makes use of minimum inhibitory concentrations (MIC) of clinically relevant bacteria (CRB; using the European Committee on Antimicrobial Susceptibility Testing (EUCAST) database) has been proposed to predict no effect concentrations (PNEC) for AMR development (PNECR). To help define science-based protection goals for antibiotics for use in a prospective ERA frameworks and to define safe discharge concentrations for antibiotic production and patient use this presentation will review the publicly available aquatic ecotoxicity data for antibiotics to assess the following: 1) the relative sensitivity of commonly used taxa in aquatic ecotoxicity to antibiotics; 2) the value of extending the toxicity testing to a more diverse range of bacteria species and: 3) how a PNEC relates to the PNEC derived for surface waters (PNECSW) using standard ecotoxicity testing. This presentation will describe (i) the output of this analysis of protection goal data and (ii) how the wider pharmaceutical industry are addressing concerns with antibiotic residues associated with manufacturing operations.
Platform Abstracts

Modelling and monitoring of pesticides fate and exposure in a regulatory context (I)

1 The SETAC DRAW workshops - aims, approaches and progress to date

In order to develop a more complete understanding of spray drift to improve the regulatory basis for representation in risk assessments, a set of SETAC workshops known as DRAW (Drift Risk Assessment Workshops) are underway to facilitate a range of efforts: Assemble and interpret a database of the spray drift trials for boom sprayers; Develop a programme of trials to more fully characterise drift influences; Use this information to develop proposals for standardized protocols for drift characterization in the field Develop an enhanced role for mathematical modelling as a higher tier risk assessment option; and Expand and reinforce the toolbox of regulatory risk mitigation measures. This presentation will focus upon; Database development and study design The workshop database currently comprises 56,001 data points from a wide range of studies, providing a rich, complex basis for supporting a range of different research efforts. Because of the variation in study designs and the consequent difficulties with interpretation there is a clear motivation to develop a more detailed and tightly defined protocol to support future research efforts. This presentation will summarise the database and efforts to develop and test a protocol to support further research efforts. Modelling Options for developing an expanded role for modelling of drift profiles have been focussed upon evaluations of two models that have been used within a regulatory context in the EU; IDEFICS and the SSAU Arabale Crop Spray Drift Model. This presentation will report on model assessment efforts, potential future improvements in process representation and consider options for regulatory scenario development. Flexibility in risk mitigation An earlier workshop (SETAC MAGPie) compiled a toolbox of risk mitigation measures in use in Europe and recommended development of communication tools to support broader and more effective implementation and encourage certification and testing harmonisation. This presentation will summarise the efforts underway in SETAC DRAW to realise these objectives through the creation of a platform to support exchange on scientific, technical, professional, and legislative or regulatory aspects of the toolbox, to further develop its accuracy and effectiveness (https://www.spraydriftmitigation.info/).

2 Plant uptake in regulatory environmental exposure assessment: Refined modelling based on experimental data
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A novel study design to determine plant uptake of chemicals for environmental fate modelling was developed and tested in a tiered approach. Ten laboratory experiments were designed to test the uptake testing participated in a round robin test and studied uptake of [14C]-1,2,4-triazole by wheat plants. Afterwards, uptake of ten radio-labelled chemicals with various properties by potato, tomato or wheat plants was investigated in two laboratories. The findings showed acceptable inter-laboratory variability and proved the applicability of the design to various compound/crop combinations. Experimental Transpiration Stream Concentration Factor (TSCF) values were higher than calculated values, implying that the equation of Briggs et al. (1982) underestimates plant uptake of compounds with logKow values of less than 2. Results obtained with this study type are suggested to be used for regulatory environmental exposure assessments. These schemes are usually based on a tiered approach, where modelling with refined model parameters is one of the higher tier options. One example is the plant uptake factor that is considered e.g. in the course of the leaching assessment according to FOCUS Groundwater. Consideration of plant uptake (dissolved compound mass is taken up into plants with the soil porewater) decreases compound mass in soil and can lead to more realistic predicted environmental concentrations. Recent guidance proposes a default uptake factor of 0 for modelling and suggests two refinement options, where TSCF values are derived from the logKow of a substance (Briggs et al., 1982) and the substance specific TSCF value from “uptake experiments with appropriate and agreed set-up to be developed” (EFSA, 2013; EU Com, 2014). The presented study design was explicitly developed to address the need identified by EFSA and was based on suggestions from the EUregPUG workshop (York, 2013) where participants from academia, authorities and industry met to establish an up to date understanding of plant uptake science. Lessons learned from the testing and continuous exchange with academia and authorities facilitated optimization of the study design. The current version of the study design is considered appropriate to produce reliable data on plant uptake to be used as input for refined exposure modelling. An explicit guidance, however, on how to integrate the requested study design into the regulatory process is still lacking.

3 Work of a SETAC Group to Develop the Scientific Basis for Guidance for Regulatory Groundwater Monitoring of Crop Protection Products and their Metabolites in Europe
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Groundwater monitoring is considered a higher tier assessment in the regulatory groundwater assessment of crop protection products in Europe, but little guidance about how to design such studies has been provided to date. The SETAC EMAG-Pest GW group (a mixture of regulatory, academic, and industry scientists) in 2015 began developing the scientific basis for guidance for use by regulators and industry scientists. Rigid study designs are not appropriate since the study design needs to be tailored to the specific study objectives and should consider environmental conditions, the properties affecting environmental behaviour of the substance being studied, and site and use conditions. To illustrate how study design can vary, the group has proposed general study designs for seven hypothetical exposure assessment options, ranging from protecting all zones of saturation below the soil surface to only groundwater used to supply drinking water. Designs include recommendations on in-field and edge of field studies, as well as studies focused on catchments and aquifers. Examples of proposed scenarios and recommendations on the use of publicly available monitoring data have also been included. Also general recommendations on well installation and sampling procedures have been provided. Methodology has also been developed for assessing the relative vulnerability of agricultural regions and the vulnerability of specific sites for use in study design and site selection. The work of SETAC EMAG-Pest GW is still in progress but the goal is to finish by mid-2018.

4 Effect of the Freundlich exponent on the finite penetration depth in a homogeneous Freundlich-SFO leaching system
J. Boesten, Wageningen Environmental Research

All models used in the EU pesticide leaching assessment since 2000 (PELMO, PEALR, PRZM and MACRO) are based on a Freundlich isotherm combined with a single first-order (SFO) degradation of the pesticide concentration in total soil. Thus, this is one of the cornerstone of the EU regulatory leaching assessment. This assessment is based on the FOCUS groundwater scenarios which use weather series of tens of years and include crop development and heterogeneous soil profiles. The sensitivity of the FOCUS leaching concentration (evaluated at 1 m depth) to the parameter describing the curvature of the Freundlich isotherm (i.e. the Freundlich exponent N) as derived from simulations with these models shows a sharp decline with decreasing Freundlich exponent with the concentration going down to a submolecular level. This is counterintuitive and difficult to understand. Explanations may be found by studying a simplified version of these sophisticated models, i.e. a assuming a homogenous soil profile with pesticide properties that are constant with depth and assuming a constant water flow rate and a constant volume fraction of water (further called ‘simplified Freundlich-SFO system’). Previously it was shown that a pulse of pesticide applied at the soil surface in this simplified system has a finite leaching depth beyond which no pesticide molecule ever passes. Simulated values of N for a few FOCUS groundwater scenarios were compared to this effect on the percentage leached with this simplified model and qualitatively these effects were found to be similar. Next it was shown that this finite penetration depth after infinite time in the simplified Freundlich-SFO system increases slowly when N increases from 0.5 to about 0.85; however, when N approaches 1, this finite penetration depth goes to infinity. This was expected because this finite penetration depth does only occur in a system with a Freundlich isotherm and not in a system with a linear isotherm. It was checked by inspection of a concentration profile of one of the FOCUS groundwater scenarios that these scenarios also show a finite penetration depth for low N values at the end.
of the simulation period.

5 Bespoke monitoring to support Tier 4 FOCUS groundwater assessment
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Data generated from this bespoke groundwater monitoring programme will offer a solution to address the non-relevance case of pinoxaden metabolites from an exposure side. Median modelled mass flux was determined using GeoPEARL. 3.3.3 simulations over 20 years which represent vulnerability to leaching across the EU27 under standard conditions. These data were aggregated to a 10km² level and combined with a shallow groundwater dataset and a cereal land use dataset based on wheat in CAPRI. Those grid cells in the upper 50th percentile for each spatial layer (mass flux, shallow groundwater, and wheat) were considered for the site selection process. Sites identified by modelling were assessed during site walkover surveys. To justify inclusion in the programme, sites had to have a history of pinoxaden use, groundwater less than 10m bgl, no confining layers, and no influential features which may act as preferential flow pathways. In 2015, 70 sites were installed across France, Germany, Italy, Lithuania and the United Kingdom. Each site consisted of three shallow wells installed around the field perimeter. The 70 sites represent all EU FOCUS groundwater scenarios except Jokioinen. The sites have all had a minimum of two pinoxaden applications before 2016 with groundwater levels an average of 2.9m below ground level. Sampling began in 2015 from 84 down hydraulic gradient wells. Of the 871 samples collected between June 2015 and July 2017 from these 70 vulnerable sites, the average for each site never exceeded 0.1µg/L. Only minor residues of metabolites have been detected since sampling began. Monitoring is to continue until Q4 2019 to ensure a thorough assessment of groundwater vulnerability is made. The modelling approach should allow extrapolation of the modelled vulnerability to be extended to member states outside of those where the wells were installed.

6 Long-Term Trend of Aquatic Pesticide Risk
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European Union member states aim at reducing ecological risks exerted by pesticides. For this, reliable trend indicators of pesticide exposure and risk are inevitable. Based on this demand we designed a long-term trend indicator of aquatic pesticide risk for Germany. It uses pesticide sale statistics, toxicity data and chemical properties as input variables. The trend indicator was designed by combining the most reliable exposure and effect models. (i) We selected the most amount of two pinoxaden applications before 2016 with groundwater levels an average of 2.9m below ground level. Sampling began in 2015 from 84 down hydraulic gradient wells. Of the 871 samples collected between June 2015 and July 2017 from these 70 vulnerable sites, the average for each site never exceeded 0.1µg/L. Only minor residues of metabolites have been detected since sampling began. Monitoring is to continue until Q4 2019 to ensure a thorough assessment of groundwater vulnerability is made. The modelling approach should allow extrapolation of the modelled vulnerability to be extended to member states outside of those where the wells were installed.

Hydropobic Chemicals and Mixtures: Reliable Investigations on their Environmental Fate and Effects (I)

7 The hydropobicity delay: symptoms and solutions
A. Celsius, Queens University; D. Mackay, Trent University / Chemistry; D. Powell, DMER Ltd.; J. Parnis, Trent University / Cemistry

The objective of this presentation is to set out the conditions under which chemicals of high hydropobicity are significantly delayed in approaching equilibrium conditions. We suggest that this delay may be misinterpreted as being caused by a change in partitioning behaviour or mechanism resulting in development of non-linear regression models describing inter-media partitioning. In reality, the partitioning is fundamentally linear but is distorted by a kinetic delay. The rate constant format commonly applied to fish biotake from water of concentration \(C_w\) is not sufficient for determining fish concentration, \(k_f\) and \(k_s\) are the uptake and loss rate constants and \(k_{BCF}\) where BCF is the bioconcentration factor. The characteristic time for uptake and loss \(t_s = L/k_{BCF}/k_s\). Slower uptake and loss will occur if the partition ratio \(K_{OW}\) is large, and the fish must contact \(K_{OW}\) times its own volume to approach equilibrium. Very hydropobic substances will experience long time delays when approaching equilibrium and correspondingly long times for loss during a depuration phase. Mackay et al. [1] modeled bioconcentration and toxicity of superhydrophobic chemicals D4, D5, and D6 using a biooeptake model for fish. Due to the very high hydrophobicity (log \(K_{OW}\)10³ for D5) and very low water solubilities, \(C_{OW}\) must be very low, which results in a very long equilibration time. Uptake time to equilibrium for D5 was estimated to be \(2\times10^4\) days, or to get \(C_{OW}=2\) mol/L about 17 days. The study concluded that for superhydrophobic substances organisms will likely not reach toxic concentrations within the test duration which is usually 4-94h. Doucette et al. [3] reviewed foliage/air partitioning data in which the onset of a hydrophobic delay (HD) is apparent when \(\log K_{OW}\) exceeds 4 [5]. Development of a model for uptake of hydrophobic chemicals by foliage. This model shows levelling off corresponding to insufficient time to achieve equilibrium. A kinetically limited regime is reached at a \(K_{OW}=10^{10}\). In our presentation we will address the HD issue that we believe is a widespread phenomenon applicable to numerous environmental systems including passive sampling and partitioning to aerosol particles. Finally, we suggest a general method for identifying the HD problem. [1] Environ Sci Technol 2015, 49(19): 11913-22. [2] Environ Toxicol Chem 2012, 31(8):1911-9. [3] Environ Toxicol Chem 2017, Accepted. [4] Environ Sci Technol 1999 33:1799-1804.

8 Partitioning of chlorinated paraffins (CPs) to organic matter is not class specific: implications for bioaccumulation?
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Chlorinated paraffins (CPs) belong to a group of industrial chemicals consisting of n-alkanes (from 10 to 30 carbon chain atoms) with chlorine content from 30% to 70% weight. They are widely used as high-pressure lubricants, flame retardants, and additives in plastic, rubber, and sealants, leading to high-production volumes worldwide. These chemicals are also ubiquitously found in the environment. The use of short chain chlorinated paraffins (SCCPs) in Europe has been restricted, however, medium (MCCPs) and long chain (LCCPs) chlorinated paraffins are used in Europe as substitutes for SCCPs. In some countries, all classes are still in use, leading to high production volumes (over a million tons per year globally). There is a lack of data on CP physicochemical and hazard-based properties, which is due to their inherent high complexity. CPs are hydrophobic contaminants, which complicates their aquatic toxicity testing. In this work, we validate the use of passive dosing for the study of partitioning and paraffin-related toxicity. We tested the partitioning behavior of CP technical mixtures between silicone, water and organic carbon. We used 5 different technical mixtures from the three established categories (2 SCCPs, 1 MCCP, 1 LCCP). We added Daphnia magna to the passive dosing system, to understand the partitioning behavior of CP technical mixtures from CP-dosed water medium to CP-free organic matter (K_{OW}).

9 Trophic magnification of cyclic volatile siloxane materials (D4, D5, and D6) in a freshwater lake: A Monte-Carlo analysis

The trophic transfer of cyclic methylsiloxane (cVMS) materials in aquatic ecosystems is an important criterion for assessing bioaccumulation and ecological risk. The use of cVMS materials are biomagnified in this freshwater ecosystem. To determine Food web magnification of the cVMS materials, a Monte Carlo analysis was conducted to determine the biomagnification and TMF value of a reference material, 2,2',3,3',4,4',5,5'-heptachlorobiphenyl (PCB-180), in Lake Pepin. TMFs for the three cVMS materials and PCB-180 were determined using standard
methods involving feeding guild, trophic guild classifications, and the stable isotopes of nitrogen (d15N) and carbon (d13C) to estimate trophic position/carbon flow. The aquatic food web consisting of two benthic macroinvertebrate species and 15 fish species was evaluated for trophic magnification of cVMS materials and PCB-180. Lipid-normalized concentrations of D4, D5, and D6 were greatest in the lowest trophic levels and significantly decreased going up the food web, with the lowest concentrations being observed in the highest trophic levels. The TFMs measured for the three cVMS materials were all99% of the uncertainty for cVMS TFMs values in Lake Pepin was explained by uncertainty at the base of the food web (89%) and at the top of the food web (11%). By comparison, PCB-180 had a TF of 2.2 in the evaluated food web, indicating biomagnification. TFMs for the cVMS chemicals and PCB-180 were determined using a Monte-Carlo probability analysis technique, and the likelihood that the values exceeded unity was less than 0.5% for all three cVMS compounds and >99.5% for PCB-180. This evaluation indicates that D4, D5, and D6 do not biomagnify in the benthic–dominated Lake Pepin aquatic ecosystem, a food web which does demonstrate biomagnification of the legacy contaminant, PCB-180.

10 Distribution and Bioaccumulation of Polyhalogenated Carbazoles in Aquatic Systems from the United States and China

D. Chen, Jinan University / Cooperative Wildlife Research Laboratory and Department of Zoology; Y. Wu, Southern Illinois University Carbondale / Cooperative Wildlife Research Laboratory and Department of Zoology; R. Sutton, Sartorius Stedim Biotech; A. Li, Jinan University / Cooperative Wildlife Research Laboratory and Department of Zoology; K. Xu, Louisiana State University / Department of Oceanography and Coastal Sciences

The present study reports the discovery of a suite of polyhalogenated carbazoles (PHCZs) in aquatic sediments collected from four watersheds located in the United States and China, including the Gulf of Mexico (USA), San Francisco Bay (USA), Lake Tai (China), and Lake Dian Shan (China), and their bioaccumulation in the San Francisco Bay ecosystem. A total of 11 halogenated carbazoles, including 3-chloro-3,6-dichloro-1,3,6,8-tetrahydro-2,2,3,6,7,7,8,9-octachloro-3-bromo-3,6-dibromo-3,6-dibromo-3,6-dibromo-3,6-tribromo-1,3,6,8-tetrahydro-1-bromo-3,6-dichloro-, and 1,8-dibromo-3,6-dichloro-carbazole were screened. Halogenated carbazoles were detected in 98.7% of the sediment samples, with concentrations ranging from below method limits of quantification to 51.5 ng/g dry weight. In most of these sediment samples, PHCZ concentrations exceeded those of polychlorinated flame retardants (PBDEs). The latter group of chemicals has been demonstrated to be persistent and globally distributed. PHCZs were also detected in various organisms from the San Francisco Bay, including bivalves, sport fish, harbor seal blubber and bird eggs. The median concentrations of PHCZs by species ranged from 33.7 to 164 ng/g lipid weight. Biomagnification was also observed from fish to harbor seal and was mainly driven by chlorinated carbazoles, particularly 36-CCZ. Congener compositions differed among species, suggesting that individual congeners may be subject to different bioaccumulation or metabolism in species occupying various trophic levels in the studies system. Toxic equivalent (TEQ) values of PHCZs were determined on the basis of their relative effect potencies (REPs) compared to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The median TEQ ranged from 4.8 to 19.5 pg TEQ/g lipid weight in biological tissues. Our data demonstrated the broad exposure of PHCZs in the systems studied and potential in globally aquatic systems. These findings raise the need of additional research to better elucidate their sources, environmental behavior, and fate in global environments.

11 Bioconcentration factors of contaminants of essential oils in fish determined in an in vivo benchmarked dietary exposure study: A case study for pine oil

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Environmental Life Cycle Assessment (LCA) relies on data, models and knowledge from almost all environmental scientific disciplines, including related uncertainties. In addition, LCA involves making methodological choices. Over the past five years, we have published several approaches to deal with data and methodological choice uncertainties. One often heard critique is that these proposals do not account yet for ‘correlations’. We distinguish between two meanings of the term ‘correlations: correlated sampling: when applying Monte Carlo sampling for propagating uncertainty data for a comparative LCA study, the sampling can be either dependent (correlated) or independent (uncorrelated).

Independent sampling implies that process data for the product alternatives compared are sampled independently from one another. The data do not account for correlations.

Correlated data consist of data from shared processes where the standard error of the model.predicted values are dependent on the data from the same process. We assume that the uncertainty computations are dependent on the same process if they are based on the same data set. The data do not account for correlations.

In an LCA study, the process data are dependent on the same data set. The data do not account for correlations.

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framework in the daily practice of LCA practitioners needs further work, including implementation in LCA software programs and particularly data.

14 Drivers of variability and uncertainty in the chemical footprint of personal care products
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Chemical footprinting of products, quantifying the potential environmental impact of the product’s chemicals, could be used to inform consumers choice. However, the use of chemical footprints (ChFs) for comparative purposes requires a full understanding of the uncertainty and variability sources influencing its quantification. The goal of this work was to determine the ChFs for personal care products and quantify the variability and uncertainty in the different parameters used to derive these individual ChFs. In a first phase, we focused on shampoos. The environmental impact of each ingredient was derived from an environmental load, assuming 100% discharge to the drain, determined by the ingredient’s removal in activated sludge wastewater treatment plants (WWTPs) simulated using SimpleTreat, and a characterisation factor estimated with USEtox. The physico-chemical and ecotoxicological properties applied in both models were all estimated. Their reliability was derived from the prediction accuracy of the estimation models used (EPSSuite, ACD Labs, ECOSAR). A Monte Carlo analysis with 1000 iterations was then performed, combining the uncertainty and variability of the different parameters, to determine the spread in ChFs. The ChFs derived by this approach spanned nearly 4 orders of magnitude (95% Confidence Interval (CI)). The wide span of the CI’s 95% CI was primarily attributable to fragrances (61%), surfactants (20%), and the amount of production (16%). The significant contribution from fragrances and surfactants can largely be explained by the uncertainty in their environmental impacts described by the characterisation factors derived with USEtox and more precisely the estimated ecotoxicity values. These preliminary results question the use of absolute values when communicating product’s chemical footprints. As long as more reliable ecotoxicological assessments are not available, identifying relative contributions to the overall environmental impacts might be more useful to target specific actions.

15 Combined uncertainty and scenario analysis within Life Cycle Assessment of waste management systems
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Life Cycle Assessment (LCA) is being increasingly used for decision support in the waste management field. LCAs are subject to uncertainty regarding both the input values for the LCA model (parametrical uncertainty) and its modelling choices (or epistemic uncertainty). Parametrical uncertainty can be systematically addressed with parametrical uncertainty analysis, while epistemic uncertainty can be addressed with scenario analysis. However, the communicability and usefulness of these two analyses can be hindered by the fact that such analyses are carried out separately, dividing the interpretation of the results in two separate channels and potentially limiting the value of LCA as a decision support tool. This study presents a novel method that aims at combining uncertainty and scenario analysis, illustrated on a case study on three hypothetical waste management options for treatment of residual household waste in the municipality of Copenhagen in 2025. The waste management solutions were provided with uncertainty for the model input values (parametrical uncertainty) and were assessed within four different hypothetical background conditions (scenario analysis). Within each impact category, the results of the parametrical uncertainty analysis were used to identify the most robust waste management option, i.e. the waste management option obtaining the highest average probability measure of providing the best environmental performance across the considered background scenarios. The method allowed obtaining various levels of analyses for the interpretation of the LCIA results: parametrical uncertainty analysis for each of the assessed waste management options, with identification of the parameters mostly contributing to the uncertainty around the results, within each of the assessed scenarios for the background conditions. The parametrical uncertainty analysis is necessary for carrying out discernibility analyses across background conditions, allowing obtaining useful insights on the changes in sensitive parameters induced by the change in background conditions. The discernibility analysis results allowed obtaining a clear quantification of the probability measure of each waste management option to provide a better environmental performance than another, for each of the assessed impact categories and investigated background conditions, and in a manner simply conveyable to the users and final receivers of the LCA. Which impact categories are relevant for LCA results interpretation?
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LCA is intrinsically a multicriteria approach comparing (almost) all the potential environmental impacts of human activities. However, multicriteria decisions pose challenges as a wide range of environmental impacts results may lead to unclear conclusions. Based on their relevance, a choice among the impact categories may be necessary. It can be carried out by examining how the information given in the Life Cycle Inventories (LCIs) is used by the impact categories. The Representativeness Index (RI) proposed by Esnouf et al. was initially used to compare the adequacy of Life Cycle Impact Assessment (LCIA) methods regarding LCIs. Here, the RI is used to explore the impact categories belonging to a given LCIA method. Thus, the present study focuses on how the interpretation of the LCA results can be undertaken given the choice of relevant impact categories. With a geometrical standpoint, LCIs of the ecoinvent database and impact categories of the ILCD method are standardized and localized within the same R vector space. This vector space is generated by all the dimensions (i.e. elementary flows) from which the LCIs of the database are derived. The RI is a proximity measurement between the standardized LCI vectors and standardized impact category vectors, corresponding to the cosine of the angle between two vectors. This measurement does not assess the relevance of the environmental model behind impact categories, but rather translates the main elementary flows from an LCI based on how they are represented by the impact categories of an LCIA method. Two inventories referred variability. Life Cycle Inventory (LCI) regionalization deals with studying the geographic representativeness modelled in LCI. Life Cycle Impact Assessment (LCIA) regionalization deals with regionalized impact characterization that accounts for the spatial variability of the receiving environment. Regionalized characterization factors (CF) apply to spatialized elementary flows (EF), called LCI spatialization. However, integrating regionalization requires additional effort on data collection and treatment for LCA practitioners and database developers. Thus, prioritizing the regionalization effort on the most sensitive data (input data with uncertainty having the highest influence on the resulting uncertainty) would ensure an optimal use of resources to reduce LCA results uncertainty. This research work proposes a procedure to prioritize regionalization efforts based on global sensitivity analysis (GSA) to reduce the spatial uncertainty of LCA results. We applied this procedure to all the activities of two economic sectors (biofuel production and passenger land transport) defined in the ecoinvent database v3. The regionalized impact methodology IMPACT Worldv+ is used to assess environmental impacts. Statistical tests are then used to derive sectoral recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. These recommendations mean that practitioners and LCI database developers need to redefine their strategy for regional data collection to lower the LCA results uncertainty. Results show that contrasting IC ranking depending on the economic sector. For the biofuel production sector, land transformation encompasses almost all the uncertainty, whereas it is distributed among several impacts (global warming and marine acidification) on the land passenger transport sector. For LCA phases that are regionalized, it is recommended that inventory should be spatialized in priority for regionalized impact categories. This methodology allows providing different recommendations specific a sector to refine data collection in order to reduce uncertainty and enhance results interpretation. To our knowledge, this is the first time that an uncertainty analysis discriminating IC and LCA phase ranking has been performed.

18 Poster spotlight: MO387, MO388, MO389
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (I)

Unravelling longitudinal pollution patterns in freshwater by non-target screening and cluster analysis

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Pollution of aquatic ecosystems with emerging organic contaminants (EOCs) has been intensively studied over the past decades. The vast number of EOCs and their occurrence in complex and variable mixtures is a major challenge for monitoring, risk assessment and management and is beyond the scope of target screening. Thus, novel approaches are needed to characterize these mixtures and identify unknown EOCs including transformation products and natural background. In this study, we propose a novel workflow for unravelling pollution patterns along a river course, identifying longitudinal dynamics of pollutant groups, entry pathways and the fate of EOCs along the river course using non-target screening by LC-HRMS and cluster analysis. Sixteen grab samples were taken along the 42 km-long course of the Holtemme River (Saxony-Anhalt, Germany), whereas the first sampling in the national park marked a reference point for pristine conditions. Chemical screening was performed on an UltiMate 3000 LC system (Thermo Scientific) coupled to a hybrid quadrupole - Orbitrap MS (QExactiveTM Plus, Thermo Scientific) with a heated electrospray ionization source. MS/MS analysis was performed in a full scan experiment (100-1000 m/z) at a nominal resolving power of 140,000 at m/z 200. Peak extraction including peak picking, gap filling, componentization and target annotation was implemented in R. Cluster analysis was performed using the R package ‘kml’. Four clusters were suggested for the data set representing A: EOCs from treated wastewater input of the two wastewater treatment plants (WWTP), B: EOCs specific for first WWTP due to specific local emissions, C: EOCs from diffuse (i.e., agricultural and urban surface run-off) and small point-source input (e.g., rain sewers and creeks) and D: low continuous background signals. The identified patterns gave insights into the spatial dynamics of complex chemical mixtures along a river course, highlighting differences in point-sources and areas governed by diffuse input and identifying points of complex mixtures of mixtures (e.g., first WWTP). Deeper investigation including structure elucidation will resolve the origin of non-target signals in these clusters. The proposed workflow proved to be a fast method for unravelling pollution patterns in non-target HRMS data and may also applied to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

Tracing sewage-derived contaminants from mainland towards the ocean by high resolution mass spectrometry

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EOCs of antibiotics and pharmaceuticals are relevant constituents of emerging contaminants. In this study, we investigated the occurrence and distribution of 15 pharmaceuticals and personal care products (PPCPs) and five artificial sweeteners (ASWs) in surface and groundwater of the Ganges River Basin in India. The Ganges River Basin is the largest river basin in India and home of about 7% of the total global population. PPCPs and ASWs were ubiquitously present in the river and groundwater. Most frequently detected compounds were caffeine, DEET, ketoprofen, cyclamate and saccharose. Except caffeine and DEET, concentrations of other PPCPs and ASWs in river water were found to be higher in densely populated areas. Concentrations of PPCPs and ASWs in the groundwater were lower but on same order as detected in the river water. Similar to river water, elevated concentrations of PPCPs and ASWs in groundwater were detected in middle and lower reaches along the Ganges River. PPCPs and ASWs were detected at lower concentrations in some countries than in developed countries, still, their instantaneous loads in the Ganges River were comparable to those in rivers from developed countries. The presence of PPCPs and ASWs in the surface and groundwater can be interpreted as a consequence of inefficient wastewater management in the basin, which pose a concern for human exposure.

Data-dependent fragment ion search for detection of sartans and related compounds in wastewater and surface water

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Presence of polar contaminants like angiotensin II receptor antagonist pharmaceuticals (sartans) in the aquatic system is a concern for human exposure. Like other xenobiotics, they can be metabolised in the body with enzymes such as cytochrome P450 (CYP), UDP-glucuronosyltransferase (UGT), and glutathione S-transferases (GST) which are present in the human liver at high abundance. Due to biological and/or abiotic processes that the contaminants undergo from the discharge site to the ground or surface water where they are detected, they can be transformed to transformation products (TPs). These TPs are usually detected and identified first at lab-scale in order to evaluate the degradability of a compound. This is typically followed by a targeted method development and it is not up until the compounds have been identified in some cases isolated that they are actually searched for in real aquatic samples to report their presence. Here, we propose an alternative approach, based on data-dependent fragment ion search, where real-world samples are initially screened for plausible TPs, metabolites or related compounds. The starting point here was a suspect screening of a list of all marketed sartans in wastewater effluent and surface water samples, which were extracted with a generic solid-phase extraction method using four cartridges with different chemistries. Out of the compounds detected, five of them had an identical core structure, and it was postulated that this sub-structure would fragment identically in all compounds. Following a series of experiments with different MS parameters modified, a list of hit compounds was obtained using fragment ion search. After all of the compounds investigated, available human metabolites and internal standards were purchased, a set of biodegradation experiments using activated sludge was performed in order to “source” the detected m/z and compare the possible TPs fragmentation to the one obtained in the bio-reactors. In parallel, a literature search for reported human metabolites was used to complement the identification of compounds detected in cases where no such compound was found to bio-form from the parent compound. Finally, a targeted method was developed for the identification of these compounds in the presence of interfering compounds in the wastewater. This work was possible due to support from EU-FP7 programme (Solutions project), Merck (LC columns) and Biotage (SPE cartridges).

HR-MS non-target analysis for transformation products of emerging organic contaminants in wastewater fractions pre-screened by ELISA


High-Resolution Mass Spectrometry has its benefits but still wastewater samples challenge the analyst on the quest for “unknowns”, metabolites and transformation products of emerging organic contaminants (EOCs). Their detection requires non-target analysis which involves not only costly instrumentation but also scientists with the time to plough through the enormous amount of data collected. An approach is presented using antibodies as selectors to pre-screen fractions of an
HPLC run for “binding” in order to detect hitherto unknown but structurally related compounds. Carbamazepine (CBZ), an anti-convulsant and anti-depressant, sulfamethoxazole (SMX), an antimicrobial for humans, and estrone (E1), a hormone and estradiol metabolite have been studied by this LC-ELISA approach. Immunoassays had been developed for all compounds but overestimations of wastewater concentrations were frequent, with CBZ even at a constant level (+30%) that did not result from the considered cross-reactivity to CBZ-11,12-epoxide (ca. 70%) or 2-hydroxy-CBZ (14%). Fractions from HPLC runs of pre-concentrated wastewater samples were collected into a 96-well glass plate in small aliquots, with fractions adapted to the desired resolution along the run. One plate is sufficient to collect a 30–40 min run. The fractions were evaporated to dryness under a gentle stream of nitrogen. Before ELISA analysis, all fractions were washed once with Tween 20-containing PBS and 0.1% acetic acid. LC-TOF-ESI-MS applied on a specifically “positive” fraction revealed an exact mass of m/z = 389.168 and a chlorine pattern. The compound is cetirizine, an antihistaminic. It appeared in our samples from spring on and was responsible for 20% of the overestimation we found initially with the CBZ antibody. The LC-ELISA for SMX displayed a series of unidentified peaks in the ELISAgram. Careful analysis of the fractions led to the identification of N4-acetylsulfamethoxazole, an SMX metabolite which is present in the samples. With estrone, interferences by polar matrix compounds eluting early could be identified.

24. Designing a risk based monitoring program for groundwater sources for drinking water production – based on target and suspect screening combined with clustering techniques

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Drinking water utilities heavily invest in monitoring occurrence of chemicals in drinking water sources and produced drinking water. Worldwide, drinking water regulation prescribes drinking water limits for a limited number of chemicals, the EU Drinking Water Directive (EU DWD) for example lists drinking water limits for 26 organic and inorganic chemical parameters. However, most drinking water utilities monitor a broad set of parent chemicals and their transformation products, using both target, non-target and biocatastrophic methods. The EU DWD states that drinking water monitoring is performed in a more flexible way, provided protection of public health is ensured. Compared to surface water, groundwater is less intensively studied and monitored. However, groundwater can be highly influenced, by anthropogenic activities related to the land-use above the groundwater, by infiltrating surface water, by historical contamination as well as by activities in the sub-soil. The susceptibility of the groundwater aquifers to these pressures depends on soil type and groundwater hydrology. Chemical properties such as persistence and mobility and their retardation during groundwater flow are reflected in the spatio-temporal patterns of the chemicals. Treatment technology applied, such as filtration and sorption techniques, determines removal efficiencies during drinking water production for specific compounds. Water utility Vitem services drinking water in a large area in the Netherlands, mostly using groundwater as a source. Their set of chemical parameters in the monitoring program tripled in the last decade. The water utility aims to prioritize their measured chemicals and develop a tailored risk-based monitoring program. We propose the idea of the development of a risk-based monitoring program for all EU supply zones involved, mostly consisting of groundwater. We use both target and non-target/suspect monitoring data and well characteristics. We use clustering techniques combined with prioritization techniques including substance properties and in vivo as well as in vitro toxicity information. We analyse full scale removal efficiencies by the treatment technologies applied. Finally we propose a risk based monitoring program.

Wildlife ecotoxicology: laboratory dosing studies to field population assessments (I)

25. An interspecies correlation model to predict acute dermal toxicity of plant protection products to terrestrial life stages of amphibians

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In this presentation, a model to predict acute dermal toxicity of plant protection products to terrestrial amphibian life stages from (regulatory) fish data will be presented. By combining existing concepts, including interspecies correlation estimation (ICE), allometric relations, lethal body burden (LBB) and bioconcentration modelling, an equation was derived that predicts the amphibian median lethal dermal dose (LD50) from standard acute toxicity values (96-h LC50) for fish and bioconcentration factors (BCF) in fish. Where possible, fish BCF values were used to predict the parent compound. Then, BCF values were adjusted to an exposure duration of 96 h, in case steady state took longer to be achieved. The derived correlation equation is based on 32 LD50 values from acute dermal toxicity experiments with 15 different species of anuran amphibians, comprising 15 different plant protection products. The developed ICE model can be used in a screening approach to estimate the acute risk to amphibian terrestrial life stages from dermal exposures to plant protection products with organic active substances. Applying this method has the potential to reduce unnecessary testing of vertebrates.

26. Overview of the EFSA Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles

S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; P.I. Adriaanse, Alterra Wageningen University and Research Centre; A. Albrecht, Agroscope / Ecotoxicology; C. Berg, Uppsala university, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; P. Berny, VETAGRO-SUP / Toxicology; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Phytopharmacy, Athens, Greece; M. Ortiz Santanelia, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM; C. Topping, University of Aarhus; S.M. Weir, Queens University of Charlotte / Biology; F. Streissl, EFSA / Pesticides Unit; R. Smith, School of Applied Sciences, University of Huddersfield

Concerns have been raised that the current risk assessment schemes may not sufficiently cover the risk for amphibians and reptiles exposed to intended uses of plant protection products (PPP). To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles. EFSA Journal 2017: 329 pp. doi:10.2903/j.efsa.2019.27. [2]EC. 2009. Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market. OJ L 391/1

27. Ecotoxicological assessment of Caretta caretta (Linnaeus, 1758) in the Mediterranean Sea using an integrated non-invasive protocol

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In this study, we aim to address the general protection goals for non-target organisms and biodiversity in the Mediterranean Sea. The IUCLID assessment for this carnivorous long-lived reptile underlines the lack of information regarding pollution and pathogens and indicates as a priority efforts to investigate and reduce the impacts of these threats. Up to now very few studies were conducted investigating biological end point potential contamination on C. caretta. The aim of our study was to conduct the first ecotoxicological assessment of this species in the Mediterranean Sea using a non-invasive integrated methodology. We set up and applied a monitoring protocol which also includes endpoints, such as CYP1A, Lipid peroxidation, ENA assay, B esterases, never investigated before in this species. Seventy-five loggerhead turtles were sampled in a passive way in Italy, France and Greece. On-site analyses were done free-ranging along the Spanish Coasts. Blood, skin and carapace samples were used to test biomarker responses and contaminant (OCs, PAHs, Pb, Cd, Hg) levels. We measured biomarkers of exposure to lipophilic contaminants (CYP1A in skin biopsies), biomarkers of indirect and direct effects investigating neurotoxic (esterases inhibition) and estrogenic (vitellogenin) effects, oxidative stress (lipid peroxidation), genotoxicity ( Comet and ENA assays) and liver damage (Gamma Glutamyl Transferase). Elaboration of experimental results was carried out taking also into consideration different age classes of the specimens. Among the main results obtained we should underline the statistically significant correlation between
carcinogenic PAHs in blood and DNA fragmentation as well as between Cd in carapace and GGT in plasma. We measured a very sharp band with a molecular weight of 59 kDa in skin sample that can be attributed to CYP1A1, never investigated earlier in this species. We also evidenced as the youngest animals showed significantly higher DNA fragmentations, BChE inhibition and increase of GGT, these alternations can be potentially related to their coastal habits. Older specimens showed the highest levels of erythrocyte nuclear abnormalities, which may indicate a higher degree of toxicological stress. This study contributed to expand the knowledge about the ecotoxicology of C. caretta in the Mediterranean, the non-invasive protocol could also be applied to other marine ecosystems and other sea turtle species, and implemented with new endpoints in the near future.

28 Sucking clans or hunting scenes - consequences to walrus health
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The walrus (Odobenus rosmarus) is an ice-associated marine mammal with distinct feeding habits. Concentrations of the main chlorinated pollutants, namely polychlorinated biphenyls (PCBs) and chlordanes, in walruses that likely feed on seals are very high - similar to levels observed in polar bears, whereas pollutants concentrations in walruses feeding on benthos are lower. Although multiple studies have associated contaminant exposure to adverse health effects in polar bears and other marine mammals with low contaminant exposure, there are no studies to date investigating effects of pollutants in walruses. The goal of our study was to investigate contaminant and pathogen exposure and endocrine disruption in walruses feeding at different trophic levels. Samples from adult male walruses (n=39) were collected from Svalbard, Norway. Stable isotope values determined in seven body compartments indicated that all of the walruses in this study fed at a low trophic level. However, concentrations of blubber lipophilic compounds showed very high individual variation. Concentrations of chlorinated compounds have decreased since they were last studied in walruses sampled, in the same area as the current study, during 2002-2004. Plasma PFAS concentrations varied less between individuals. δ15N values in red blood cells and in white blood cells were positively related to dietary PCBs and DDT in blubber compounds, but not to PFASs. Antibodies against Brucella spp. and Toxoplasma gondii were detected in 26% and 15% of the walrus plasma samples, respectively. Presence of Brucella spp. and Toxoplasma gondii were not related to contaminant exposure or stable isotope values. Among the 5 thyroid hormone concentrations analyzed in plasma, concentrations of TT4 were negatively related to contaminant exposure. We analyzed transcript levels of 21 target genes in blood cells and 7 target genes in blubber related to endocrine and immune functions by real-time quantitative PCR. The preliminary results indicate few relationships between transcript levels of genes involved in endocrine functions and pollutant exposure.

29 Triclosan-induced embryotoxicity in the yellow-legged gull
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Triclosan (TCS) is a chemical compound extensively used as synthetic and antimicrobial agent in a wide range of personal care products. Because of its hydrophobic nature and its discharge in the sewer system, TCS accumulates in settled sewage sludge and surface water, contaminating aquatic and terrestrial ecosystems. However, and according to the current state of toxicology of TCS towards wildlife species is very scarce. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the food webs and relative long life span. Their eggs are a useful tool to monitor the levels of environmental pollutants and their potential adverse effects because these chemicals can be maternally transferred to the offspring. However, such investigation on TCS is lacking. The aim of this study was to explore, through in ovo injection, the potential embryotoxicity of TCS in the yellow-legged gull (Larus michahellis). In a within-clutch experimental design, 150 ng/g egg weight of TCS were injected into the egg yolk and the effects on embryo morphology, oxidative stress and genetic damage in embryo liver were investigated. Specifically, we were injected into the egg yolk soon before hatching (2.9±1.1 ng/g wet weight). TCS was also detected in the liver (2.3±1.1 ng/g wet weight) and limited in the brain (0.2±0.1 ng/g wet weight). TCS treatment did not show any chronic effect on embryo developmental traits. However, TCS significantly increased ROS levels and promoted GST activity, leading to a marginally non-significant increase of both oxidative and genetic damage. Thus, these findings demonstrated, for the first time in a wild bird species, that TCS may affect offspring phenotype and may represent a potential threat for coastal ecosystems.

30 Egg overspray with herbicides and fungicides reduces chick survival in red-legged partridges
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Toxicity characterization in pesticide risk assessment for birds is derived from oral exposure of adults. However, for ground-nesting species, a temporal and spatial overlap of egg laying and incubation with pesticide applications may result in direct exposure of the eggs. Using formulations commonly applied to cereal crops in spring, we conducted two experiments. In the first experiment, simulated egg overspray with pesticides and the second one the incubation of eggs on a soil that had been previously sprayed. For both experiments we used an application rate, corresponding to a 30% of the labelled application rate of each product (i.e. assuming a 70% interception by crop), and a control consisting of a water application in stead of pesticide formulations. Eggs were incubated at 37°C and 45% humidity until hatching (23-26 days). Sixteen eggs per treatment were removed from the experiment at different incubation times to analyse pesticide uptake (ongoing analyses, results will be presented at the meeting), and a minimum of N=20 per treatment was monitored for embryonic development and post-hatching survival. Chicks were weighed and measured (tarsus length), and body condition calculated, at hatching and at days 8, 16, 24 and 32 post-hatching. Egg overspray with pesticides significantly increased chick mortality (Wald’s X² = 29.909, 14 d.f., p = 0.008). Although pesticides did not affect survivorship at hatching time, in ovo exposure to both 2,4-D and tebuconazole caused increased mortality of chicks afterwards, resulting in a reduction of productivity 32 days after hatching of 30.6 and 25.9%, respectively. Incubation of eggs in pesticide applied soils did not significantly affect chick survival (Wald’s X² = 15.603, 14 d.f., p = 0.338), and nestling growth was not affected in either experiment by embryonic exposure to pesticides. These results suggest that reduction of embryonic and chick survival because of egg overspray with pesticides can be a potential way by which these pesticides could affect reproductive success. Likewise, potential interactions between the exposure period and effect occurrence need to be considered when monitoring pesticide impacts on avian reproductive output. Financed by the Spanish Ministry of Economy and Competitiveness (Project ref. CGL2016-75278-R)

Biocides and Veterinary Medicines: latest developments in regulatory risk assessment, research and monitoring

31 Regulatory improvement in the assessment of environmental risks from veterinary medicines; a European Perspective
J. Weeks, SETAC Europe 28th Annual Meeting Abstract Book
32 Risk of veterinary medicines to plants: Reflections for an updated approach.

R. Carapeto Garcia, Spanish Medicines Agency / Veterinary medicines; A. Haro Castuera, Spanish Medicines Agency / Veterinary Medicines Department; G. Corrís Ruiz, C. Rubio Montejano, Spanish Medicines Agency / Department of Veterinary Medicines

In an Environmental Risk Assessment (ERA) the General Protections Goals need to be translated into Operational Protection Goals in order to achieve efficient and robust ERAs. Not doing so hinders the process of Risk Management in those cases where a risk is identified. In the current regulatory framework of ERA of Veterinary Medicines and the use of mesocosms, the aspect of "Protection of ecosystems" is not translated into Operational Protection Goals. Hence, when risks are found it is complicated to manage or mitigate such risks. In the taxonomic level of "terrestrial plants" some VMPs have shown different levels of risks. From the Risk Assessor perspective it is difficult to deal with these risks, partly due to the lack of guidance on Operational Protection Goals. Here we analyze a proposal of use of a model and use for exposure assessments at feedlot, field, and watershed scales. Nine exposure pathways were evaluated at the feedlot and field level using, in the VMPs framework, two Operational Protection Goals in the risk assessment of terrestrial plants: "Protection of Human Interest" and "Protection of Environmental Interests".

33 Innovative environmental assessment of a veterinary medicinal product: watershed-level impacts of trenbolone acetate and 17β-estradiol

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Environmental assessments of pharmaceuticals are required by regulatory authorities as part of the drug approval process. Revalor-XR is an extended-release implant for use in cattle fed in confinement (steers and heifers) that contains trenbolone acetate and 17β-estradiol (17β-E2) as active pharmaceutical ingredients (APhIs). Both APhIs are metabolized in situ resulting in the excretion of 17β-trenbolone (17β-TB), 17α-trenbolone (17α-TB), tendron (TBO), 17β-E2, 17α-trenbolone (17α-E2), and estrone (E1). The similarity in chemical structures and modes of the environmental fate properties among 17β-TB, 17α-TB, TBO, and that among 17β-E2, 17α-E2, and E1 promote the use of surrogate compounds to represent the trenbolone compounds and the estradiol compounds in the environmental assessment. Data on the individual compounds were collected from various laboratory studies and literature sources, aggregated to generate representative values for the surrogate compounds to characterize their environmental fate, and used for exposure assessments at feedlot, field, and watershed-scales. Nine exposure pathways were evaluated at the feedlot and field scale, allowing for elimination of insignificant pathways for the watershed-scale modeling, which considered the major exposure pathways and was conducted for two representative watersheds, one in Texas and one in Iowa, using the U.S. EPA’s BASINS/HSPP model. The outputs of the modeling efforts resulted in Predicted Environmental Concentrations (PECs) for the surrogate compounds for individual as well as aggregated exposure pathways. The effects assessment was focused on potential reproductive impacts to fish from chronic exposure, which is the most sensitive ecological endpoint for these compounds, and generated Predicted No-Effect Concentrations (PNECs) for 17β-TB, 17α-TB, 17α-E2, and 17β-E2. Risk characterization involved comparison of the PECs for the surrogate compounds to the PNECs of the individual compounds. The assessment at the watershed scale demonstrated that it is highly unlikely that the compounds associated with Revalor-XR would have any significant environmental impacts when used according to the Revalor-XR label. The environmental assessment supported a Finding of No Significant Impact by the U.S. Food and Drug Administration from the use of Revalor-XR in beef steers and heifers in the US.

34 How can mesocosm studies increase realism in risk assessment of biocides and veterinary medicines?

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Mesocosm studies can be used to assess the environmental impact of potential stressors based on model-ecosystems under realistic environmental conditions. They are an important link from laboratory to field. Mesocosms provide the assessment of a broad range of different species of different ecological groups forming food webs with complex interactions. Therefore mesocosm studies can support a better understanding of the environmental impact of stressors on population level as well as on ecosystem level (e.g. direct and indirect effects on community structure and ecosystem functions as primary production). In addition, mesocosm studies provide data on the fate of test substances under realistic outdoor conditions, which can be used to test the prediction based on laboratory studies. While for the risk assessment of Plant Protection Products (PPP) mesocosm studies are an established higher tier approach and are considered as the surrogate reference tier, the use of mesocosm studies for risk assessment of biocides, veterinary medicines and chemicals under REACH is rare, although mesocosm research from the Guidance Document (broader use and chemical safety assessment - Chapter R.10: Characterisation of dose [concentration]-response for environment and in the Guidance on the Biocidal Products Regulation - Volume IV Environment - Assessment and Evaluation both provided by ECHA. One reason for this might be, that mesocosm studies have the reputation to be very complex and difficult to evaluate by regulators. This presentation intends to take some fears of contact with mesocosms. It will explain the most important aspects to validate the quality of a mesocosm study and the relevance of the results. Further, it will give some insights to the use of (aquatic) mesocosm studies in the context of PPP risk assessment and will provide important aspects for planning a mesocosm study for biocides, veterinary medicines and chemicals in the context of REACH.

35 Estimation of insecticides in mink farms

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Biotics are regulated in EU by the BPR [1]. To evaluate if an active substance (i.e., or product may be authorised, an assessment of the environmental exposure is required. For insecticides used in stables an Emission Scenario Document (ESD) [2] is used covering application methods and a range of animal categories. The ESD does not cover biocides used in minks. A scenario has therefore been developed, where emission of a.i. from mink farms is calculated based on either amount applied or measured concentration in straw. Default values have been established from regulation and general practice in mink production in the Nordic countries, where Denmark has the highest production of mink in Europe [3]. Each breeding animal is kept individually in one cage to be treated at the start of the season. Mother and cubs stay together in one cage and are separated into pairs after lactation, where all cages are retreated. Each mother will bear 5.55 cubs/year according to Danish regulation [4]. The number of “breeding females” (BF) is 1 mother+5.55 cubs. The number of nest boxes that is treated/BF can be calculated as follows: 1 animal/nest box before separation and 6.55/2 animals (=3.275)/nest boxes after separation. In Europe it is prohibited to discharge waste from stables to public sewer. Emission is therefore only expected to be to agricultural land. Emission of manure/straw can be expressed to a number of BF per ha (B = 50). Emission based on amount of straw/manure applied to the field: Y = concentration of a.i. in straw/manure x 750 kg straw per BF per ha (Eq. 1) Where Y = emission of a.i. in kg/ha x year, Qapp after sep = concentration of a.i. in the product in kg/g, Qapp after sep = amount of treatments before separation of adults and cubs, Qapp after sep = amount of treatments after separation of adults and cubs and B is amount of straw/manure that may be applied to land in number of BF/ha (B = 50). Emission based on amount of straw/manure applied to the field: Y = Concentration of a.i. in straw/manure x 750 kg straw per BF per ha (Eq. 2) Where amount of straw used per BF is 10-15 kg/year according to Kopenhagen Fur. The emission based on Nordic countries regulations and information from Kopenhagen Fur on amount of straw used per BF is 50 kg per ha x 15 kg straw per BF=750 kg straw per BF per ha. Predicted Environmental Concentration in soil may be calculated according to Volume IV Part B [5].

36 Biocidal active substances in municipal wastewater - what product groups are the sources?

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The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission from buildings, e.g. facade cleaning, have already been discussed in detail. However, until now the specific sources from the interior of these households remained unknown. To investigate the products responsible for these emissions to wastewater, we analysed the wastewater of one neighbourhood for a set of biocidal active substances and compared these results with household product inventories. Time-proportional sampling of daily samples was conducted during one week for one household. The 14 substances analysed with an LC-MS/MS method were BIT, C12-benzalkonium chloride, carbendazim, CMIT, DCOIT, DEET, diuron, icaridine, OIT, piperoxyl butoxide (PBO), triclosan, tetrabuconazole, terbutryn and tetramethrin. In comparison with data available from household product inventories of this neighbourhood, we investigated the product groups possibly being responsible for the emissions to the wastewater. Except for CMIT and DCOIT, PBO and tetramethrin, all substances have been detected in at least 10 % of the samples. Highest concentrations were measured for C12-benzalkonium chloride with an average concentration of 6.6 μg/L. Besides C12-benzalkonium chloride, BIT, DEET and icaridine were measured in all samples. The results show...
that washing and cleaning agents are important sources for preservatives such as BIT and OFF, while triclosan was apparently mainly emitted through personal care products. The mosquito repellent substances DEET and icaridine were found throughout the whole year, with highest emissions in summer and autumn. C12-benzalkonium chloride concentrations were associated with the inventoried disinfectants. Material preservatives such as terbutryn, diuron, tebuconazole or carbaryl were also detected. As these were not listed on the inventoried products, emission via treated materials such as paint, render, seals or textiles seems likely. We were able to show that biocidal active substances are emitted from the inside of households in considerable concentrations. Those emissions are not only due to biocidal products but also washing and cleaning agents, personal care products and preserved materials. For this reason, measures should not only tackle biocidal products when it comes to the reduction of biocidal active substances in wastewater.

The environment as a reactor determining fate and toxicity of nanomaterials (I)

37 Comparative multi-generation study of long-term effects of pristine and wastewater-borne silver and titanium dioxide nanoparticles on reproduction in Daphnia magna
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Manufactured nanomaterials (MNMs) and especially Ag- and TiO2-NPs are processed as daily used products such as cosmetics, clothing and in medical supplies. After passing wastewater treatment plants these MNMs reach the aquatic environment and can accumulate in the aquatic ecosystem and cause toxicity to aquatic organisms. To assess the risk potential of these NPs to aquatic invertebrates under more realistic circumstances, we investigated and compared possible effects of pristine Ag-NPs and TiO2 NPs with those after passing a model wastewater treatment plant on the reproductive success (number of offspring), mortality and body size of adult daphnia as endpoints in up to six generations. We exposed daphnia to: (i) pristine Ag-NPs (NM300K) and TiO2-NPs (NM105) or (ii) wastewater borne Ag- and TiO2-Nanoparticles from effluent from the model WWTP. The first generation of daphnia was exposed to four concentrations of Ag-NPs (nominal: 1.25 µg/L, 2.5 µg/L, 5.0 µg/L and 10.0 µg/L), to solvent control (NM100K DIS), or to three concentrations of TiO2-NPs (nominal: 25 µg/L, 50 µg/L, 100 µg/L) in line with the OECD guideline No. 211. Each generation was exposed for 21 days and started with the third brood from the previous one. In all six generations the exposure with pristine Ag-NPs (NM300K) for 21 days caused a significant reduction in the mean number of offspring in daphnia compared to the control. However, wastewater-borne Ag-NPs had no effects on reproduction in any generation. In the treated wastewater body length of daphnia was significantly larger at 5 µg/L in generation F2 and at 2.5 µg/L in generation F3 compared to the control. In the wastewater-borne Ag-NP treatment the adults’ body length was significantly larger at 2.5 µg/L. Thus, adult’s body length showed no consistent pattern towards both scenarios. When passing WWTPs most Ag-NPs might be transformed and enter the aquatic environment as silver sulfide. That may be the reason for the lower toxicity than compared to other forms of Ag-NPs. Our results provide a first, direct comparison between the toxicity of pristine Ag-NPs and TiO2-NPs with those from WWTP. To our knowledge, the present study is the first one showing that Ag-NPs from a wastewater treatment plant had a minor and no chronic toxicity to Daphnia magna. The used experimental approach allows a more realistic risk assessment of Ag-NPs and TiO2-NPs for the aquatic environment. The experiment with TiO2-NPs are in progress.

38 Development of a rapid screen to assess bioaccumulation potential: from ex vivo to in vivo using pristine and aged nanomaterials in fish
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Bioaccumulation is one of the key triggers of concern for environmental risk assessment that has had little consideration for engineered nanomaterials (ENMs). Given that ENMs undergo surface chemical reactions, agglomeration and sedimentation, the likely exposure route to higher trophic organisms (e.g., fish) is through the diet. However, the importance of the ex vivo gut sac technique to rank the bioaccumulation potential of pristine (Ag NPs) and environmentally aged (Ag-S NPs) materials. Additionally, we assess whether the results of the gut sac experiment can predict in vivo chronic dietary exposure. The gut sacs were prepared by removing the entire gastrointestinal tract and separating it into the oesophagus, stomach, anterior, mid and hind intestine compartments. Compartments were exposed by filling the lumen with one of four solutions: physiological gut saline or saline spiked with 1 mg/L Ag as AgNO3. Ag NP or Ag5S NP. Following a 4 h exposure, tissues were cut open and the mucosa was separated from the underlying muscularis, through scraping via a microscope slide. For the in vivo chronic dietary exposure, fish (n = 150) were graded into tanks (n ≥ 3 tank/treatment). Fish were fed either a control (no added Ag), 100 mg/kg as AgNO3, Ag NPs or Ag5S NPs. Fish were sampled each week (1, 2, 3 and 4; n = 2 fish/tank/time point). Following this, all tanks were placed on the control diet for another two weeks to measure Ag elimination. During sampling, the mid and hind intestine, liver, gallbladder, kidney, spleen, gut sac and carcass were dissected. Tissues from both experiments were analysed for total Ag using ICP-MS. The gut sac experiment demonstrated the uptake of Ag is associated with the mid and hind intestine. There was significantly less Ag in the musculi of the mid and hind intestine after exposure to Ag NP and Ag5S NP compared to AgNO3, but no difference between ENM treatments. The in vivo experiment demonstrated that more Ag in the mid and hind intestine of Ag NP and Ag5NO3-OE treatments compared to Ag5S NPs. Short from all the exposures were able to pass the gut epithelium and cause total concentrations in the liver to rise, despite the form being unknown. In conclusion, the ex vivo gut sac method can be used to rapidly screen the bioavailability of Ag NPs and Ag5S NPs. However, if the data are ranked in the mid and hind intestine by total Ag accumulation, the gut sac does not directly predict in vivo accumulation.

39 Fate and Effect of Wastewater Borne Manufactured Nanomaterials on the Aquatic Food Chain
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Manufactured nanomaterials (MNMs) are widely used in various applications and commercial products, e.g. textiles, sunscreens, paints, cosmetics. Even though MNMs are mostly removed during wastewater treatment, the remaining and mostly transformed MNMs in treated wastewater might be significant and may show an increased toxicity for aquatic organisms due to their modification during the WWT. The impact of wastewater-borne MNMs (TiO2 and Ag MNMs) on different trophic levels and their bioaccumulation within a relevant food chain (algae-Daphnia-fish) have been investigated with innovative analytical and experimental approaches. Several model WWTPs were conducted according to OECD guideline 301A. The collected effluents were used to perform acute and chronic tests with Daphnia magna and Oncorhynchus mykiss according to the OECD guidelines 202, 211, 215 and 305. Animals were exposed to (i) effluent from model WWTPs contaminated with MNMs, (ii) untransformed effluent, manually spiked with MNMs and (iii) dilution water enriched with pristine MNMs. Tissue samples of the different test organisms were analyzed for changes in the levels of several biochemical markers [lactic dehydrogenase (LDH), superoxide dismutase (SOD), catalase (CAT) and glutathione-S-transferase (GST)]. Furthermore, uptake and elimination kinetics of the MNMs were investigated by quantitative ICP-MS and ICPOES analysis. No chronic effects were found in D. magna after exposure to effluents with transformed AgNPs. However, when supplemented into untransformed effluents or dilution water, the analysed cofactors per adult daphnia decreased proportionally with increasing AgNP concentration. For nano-TiO2, no effects on the reproduction of D. magna could be shown at environmentally relevant concentrations. Only after chronic exposure to the very high concentrations of 5 mg/L and 10 mg/L significant effects could be shown. Neither nano-Ag nor nano-TiO2 showed an effect on the growth of juvenile rainbow trouts after 28 days of exposure. The analysis of biochemical markers showed that several effects induced by chronic exposure to MNMs were observed. However, no general effect pattern could be identified. Total MNM levels were measured in several tissue samples in D. magna and O. mykiss following exposure via the water or food. Pristine nanomaterials showed a significantly higher uptake into the test organisms compared to supplemented and treated WWTP effluents.

40 Uptake and elimination kinetics of pristine and aged silver nanoparticles in freshwater benthic organisms
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Manufactured Nanomaterials (NMs) can undergo changes in their properties and behaviour during their exposure, and this process is commonly referred to as aging. Aged nanomaterials (ANMs) can display reduced mobility, altered reactive surface chemistry, or changes to the physicochemical properties. The uptake and elimination kinetics of pristine and aged silver nanoparticles (Ag NPs and Ag5S NPs) were investigated in freshwater benthic organisms such as freshwater mussels (M. inexpectata) and phototrophic green algae (R. Penardii) and compared to data obtained from silver chloride (AgCl) experiments. All experiments used the gut sac technique to rap...
was established and combined with a battery of ecotoxicological assays and characterization techniques. The system contained activated sludge and was operated as a pre-denitrification system fed with synthetic wastewater spiked daily with 10 µg Ag NPs/L (PVP coated, 25 nm, nanoComposix) and 100 µg TiO$_2$ NPs/L (nominal primary size of 5 nm, NM-101, JRC) over a period of 5 weeks. During that period the effluents were collected weekly and the excess sludge was stored for the evaluation of the silver concentrations. Samples of the sludge at different time intervals were collected weekly and analyzed by sequential filtration and ICP-MS to determine the partitioning of NPs and their transformation products. Transmission electron microscopy and sp-ICP-MS were performed on selected samples. The effects of aged particles were assessed using a battery of bioassays including freshwater and marine algae (growth inhibition and reactive oxygen species -ROS- formation), crustaceans, as well as in vitro models of relevance for NP toxicity assessment (RTgill-W1 cell line, effects on metabolic activity, epithelial integrity, ROS formation, gene expression). The extent of the observed effects was dependent on the organism exposed, with bottom feeding organisms and algae being more sensitive, while the in vitro model was a good tool for environmental samples. Furthermore, the biosolids generated from the lab-scale continuous system were used to perform microbial microcosm experiments, giving a first insight into the fate and potential accumulation in a model terrestrial system. Experimental data generated from the continuous-flow operation of the activated sludge system and the targeted batch experiments will be used to model the fate and the removal of NPs.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (I)

44 Adapting the SIMA Process to Assess Offshore Decommissioning Options
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For several decades, the oil and gas industry has used the Net Environmental Benefit Analysis (NEBA) approach for oil spill response contingency planning. Recently, the International Oil Spill Conference (IOPC) published guidelines on the implementation of NEBA, using a novel process known as Spill Impact Mitigation Assessment (SIMA). SIMA is a science-based framework that integrates the best practices emerging in the oil spill response field and is particularly useful during the initial planning and preparation phases when many uncertainties are involved. SIMA is a method for identifying and comparing the socio-economic and environmental impacts of alternative response options, and can help decision-makers choose responses that will result in the best overall recovery of the ecological, socio-economic and cultural resources. One of the key advantages of SIMA is that it streamlines the process of evaluating different response options, reducing the time and resources needed for decision-making. SIMA is particularly useful for spills involving complex and rapidly changing environmental conditions, and can help decision-makers choose responses that will result in the best overall recovery of the ecological, socio-economic and cultural resources. One of the key advantages of SIMA is that it streamlines the process of evaluating different response options, reducing the time and resources needed for decision-making.
drawbacks of each option, thereby developing response strategy. Similarly, oil and gas operators are faced with complex options for decommissioning offshore installations as part of their decommissioning plans. There is a need to evaluate these options in a scientifically-defensible and consistent manner, while adequately assessing risks that can be challenging to assess. An adapted SIMA process could be a valuable tool for fostering collaboration between operators, stakeholders and regulatory bodies, ensuring a transparent review of engineering studies and available decommissioning options in a meaningful way. This paper evaluates the use of the SIMA process in a hypothetical decommissioning of an offshore platform to determine if this process lends itself to this purpose. It describes the challenges encountered when trying to conduct this comparative risk assessment, originally intended for oil spill response, to the task of decommissioning. Finally, it proposes adaptations to the SIMA process that might enable its use in the future as a credible tool in assessing environmental risks for oil and gas decommissioning.

45 Detection and quantification of oil contamination in vegetated areas using hyperspectral remote sensing

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In the field of oil and gas production, there is a constant challenge in developing new techniques of oil detection for prospecting (natural seeps) and environmental monitoring purposes (pipeline leaks, production mud pits). A convenient tool for tracking complex ecotoxicological effect data after large pollution events is the Remote Sensing Tool for Oil (RSTO). RSTO can discriminate among treatments, and remains robust to variations in vegetation reflectance. Results indicated that the same VI were highly correlated to TPH (r = 0.7). Finally, VI allowed identifying the brownfield from an airborne hyperspectral image at high spatial resolution, and thus confirmed the potential of this technique for assessing environmental risks deriving from oil and gas production in vegetated areas.

46 A tool for tracking complex ecotoxicological effect data after large pollution events with use of the Deepwater Horizon oil spill as a case study

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The Deepwater Horizon Oil Spill (DWHOS) in 2010 is the largest and most studied accidental marine oil spill in history. More than 100 new research studies concerning the effects of the DWHOS have been published each year since 2011. Key issues investigated include the behaviour and fate of oil in deep spills, the effects on the invertebrates, microorganisms, microbial oil degradation, oil-associated marine snow formation, oil impacts on deep water corals, seafood quality and safety, oil contaminants effects on fish, birds and marine mammals, effects of combined stressors on species and habitats, and habitat and ecosystem recovery processes. To keep order in this flow of new knowledge is an important albeit challenging task. It is essential that the lessons of DWHOS are applied globally to improve pre-spill and post-spill measures to minimize the adverse ecological impacts of the next big marine oil spill, wherever it may happen. In this presentation, we demonstrate a convenient tool for keeping track of the large amount of ecotoxicological data and knowledge that typically emerges from research and monitoring after marine pollution disasters, using the DWHOS as a case study. In addition, we provide a summary of the new insights about oil spill effects on marine ecosystems that have been gained from the DWHOS research, and identify some key knowledge gaps still remaining. The presentation will update a comprehensive review of the environmental effects of DWHOS that we recently published in Marine Pollution Bulletin.

47 Oil spill combat and effects in the Arctic coastal environment; self-cleaning potential and in situ burning

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Oil is the environmental toxins of a beaching oil spill in the Arctic, how well will the shoreline potentially be able to self-clean and will combing the oil by in situ burning at the coast just do more harm to the communities in the tidal zone? To answer these questions, several studies have been performed at the west coast of Greenland in 2016 and 2017. One aim of the studies was then to support net environmental benefit analysis, NEBA, related to oil spill in Arctic waters. A NEBA is often performed to achieve the optimal environmental effect with respect to choice of oil spill combat methodology and biology at risk. Hence, a synthesis will be presented of following studies: 1) removal rate and ecotoxicological effects of oil smother on seaweed (Fucus distichus), an important organism of the communities in the tidal coastal zone; 2) self-cleaning potential of a coastal line, including natural removal by seawater wash and physical degradation; and 3) effects on the tidal communities after combat of a beaching oil spill by in situ burning. Effects of oil smothering of the macroalgae Fucus distichus, which inhabit the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in sea were studied over a period of 2 weeks in a field test at Disko Island on the Greenland west coast. Among the results, the removal rate of oil from rocky substrate, and the potential oil on rocky surface were investigated at three locations at low Arctic, middle Arctic and high Arctic climatic regimes along the west coast of Greenland. The study included experiments of natural removal of a crude oil and a heavy fuel oil from tiles mimicking rocky shore substratum and was run in the period from May - September 2017. The tiles were placed in different height levels of the tidal zone, and hence natural removal and degradation rates in correlation to different water cover regimes and air exposure times were obtained. The oil remains on the tiles were analysed for chemical compositions. A pilot scale costal in situ burning operation was performed during summer in a bay in western Greenland with a crude oil for testing burning efficiency and environmental exposure and effects. The findings were funded by the European Commission Horizon 2020 programme and the Government of Greenland.

48 How are our indices? - differentiating between sources in a weathering environment

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Crude oil contains many hundreds of compounds and some of these are widely used to differentiate between different oils and products, especially in spill scenarios. Traditionally, we have developed chemical fingerprints based on a suite of compounds such as the terpenes and terpanes although the concept of a “fingerprint” suggests this is static in time. However, it is also well known that the degradation processes have a significant time scale and the pattern changes with period of exposure. It would be more appropriate to use a “signature” also at different oil sources by this approach. The weathering processes change the chemical signature and old oil may have a different chemical composition to the original sour oil. When we analyses such samples, we may need to ask if this is the same oil as the source proposed, or a different oil with a different signature that is also present. The terpanes and terpanes contain several homologues and analysis of the chemical signature during the Deepwater Horizon Response clearly indicated that several of these compounds were not behaving conservatively and were degrading at a faster rate than anticipated given the exposure time. Comparisons with the actual oil released clearly identifies the compounds most likely to alter the environments where they degrade. In this case, the Louisiana marshes were clearly a site where biodegradation was significantly faster than expected. This was also true of the alkylated PAHs which had been used as source identifiers in previous spills such as the Exxon Valdez. The terpanes and terpanes were also degrading at a significant rate while the oil was at sea and the exposure to UV light may have led to a relatively rapid abiotic transformation. When it comes to distinguishing between sources, less may be more! We need to select the compounds we include in our analyses with care since each question may need a different approach: if we want to know if the oil is weathering, we use a suite of compounds with differential properties appropriate to the environment of the spill. If we want to conduct source apportionment, we may need to choose the most calcareous of the compounds rather than all of them.

Fish model species in human and environmental toxicology (I)

49 Exposure to bisphenol S alters microRNA expression in male zebrafish (Danio rerio)

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In response to the restriction of bisphenol A (BPA), bisphenol S (BPS) has been widely used in the manufacturing of polycarbonate plastics and epoxy resins as an alternative compound. BPS has been found to affect reproduction, development,
and immune system. Although microRNAs (miRNAs) play a crucial role in many metabolic activities, whether and how they are involved in the process of BPS-induced toxicity is largely unknown. BPS-induced changes in miRNAs and target gene expression in male zebrafish (Danio rerio) gonad, and the potential mechanism was investigated. Male zebrafish were exposed to 0, 5, and 50 µg/L BPS for 21 d. miRNA was isolated from the gonad pool and the expression profiles of 255 known zebrafish miRNAs were analyzed using Affymetrix microarrays. Quantitative real-time PCR was used to confirm the expression of several miRNAs in the microarray data. The GO term analysis revealed that miRNAs significantly affected by BPS exposure were involved in hematopoiesis, lymphoid organ development, and immune system development. Among 14 miRNAs that were significantly regulated after exposure to 5 and 50 µg/L BPS, six were up-regulated and eight were down-regulated, which suggested that BPS-induced toxicity via the interference with the aromatization process. The results of this study will provide novel insight into the epigenetic regulatory mechanisms of BPS-induced toxicity in male zebrafish.

50 Zebrafish as a model to investigate mechanisms of adverse metabolic and cardiovascular outcomes associated with elevated dietary selenium exposure D.M. Jang, University of Saskatchewan / Toxicology Centre; C. Pettem, University of Saskatchewan - Toxicology Centre; T. Holm, University of Saskatchewan - Toxicology Centre; J. Thomas, University of Saskatchewan Toxicology Centre; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences

A variety of anthropogenic activities cause increased loading of the essential trace element selenium into aquatic ecosystems, where it poses an extreme toxicological hazard to fishes due to the narrow range between essentiality and toxicity. Although several studies have reported developmental toxicities in early life stages of fishes, fewer studies have investigated sublethal toxicological effects that may occur following dietary selenium exposure in adult fishes. Adult zebrafish were exposed to dietary selenium (0, 3, 10, and 20 µg Se/g food) at sublethal and environmentally relevant supplemented selenium levels (3.4 – 28.8 µg/g) for 90 days. Swimming performance, O2 consumption and metabolic rates were determined using a swim tunnel respirometer. Cardiac function was assessed using high resolution (30 µm) ultrasound biomicroscopy. Whole-body energy stores (triglycerides and glycogen) and mRNA transcript abundance of selected genes involved in insulin signalling and cardiac function were measured. Compared to controls, adult zebrafish exposed to elevated dietary SeMet exhibited impaired swimming performance (lower fatigue velocity or Ucrit). This was associated with elevated basal metabolic rate and reduced aerobic scope, indicating impaired aerobic capacity. Triglycerides (the primary fuel for aerobic swimming) were elevated in a dose-dependent manner, which was associated with altered transcription abundance of several genes involved in lipid homeostasis. Ultrasonography revealed decreased cardiac output, which was associated with increased echodensity at the atrial-ventricular junction and reduced mRNA expression of the collagenase, MMP2. These results suggest significant ecophysiological effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, the zebrafish model will help to identify mechanisms of energetic responses to elevated dietary selenium, which can be translated to human health studies.

51 Toxicity and neurotoxicity profiling of sediments from Gulf of Bothnia with Danio rerio embryos R. Massgi, Helmholtz Centre for Environmental Research / UFZ; H. Holpert, RWTH Aachen University / Institute for Environmental Research; M. Krauss, T. Schulze, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; C. Weidauer, Helmholtz Centre for Environmental Research UFZ; P. Hagle, C. Galampoiz, Umea University; M. Tysklind, Umea University / Department of Chemistry; W. Brack, Helmholtz Centre for Environmental Research UFZ / Department of Chemistry

Sediments are a well-known sink for a large variety of organic pollutants that may cause distress to benthic and pelagic species in case of their remobilization to the water-phase. Risk assessment of complex mixtures may involve component-based approaches applying chemical analysis together with measured or predicted toxicity data of individual components and mixture risk modeling or whole mixture approaches using mathematical models. A combination of both approaches using chemical and bio-analytical tools for characterization for example of sediment contamination is expected to provide a more comprehensive picture of toxic risks to aquatic organisms. One of the most promising organisms for diagnostic in vivo testing of sediment may be zebrafish embryos (Danio rerio) being a versatile in vivo model suitable for high-throughput analysis while keeping several advantages of in vitro approaches (i.e. low-cost, sensitivity, short duration of the test). The fish embryo test (FET) with Danio rerio has been considered as a good surrogate for the acute toxicity fish test and was successfully used in several studies for the detection of toxicity and neurotoxicity in sediments samples. One of the major advantages of the FET with Danio rerio is the possibility to monitor several toxic endpoints including the modification of biochemical and molecular processes, which can be related to the exposure of specific pollutants. The present study provides a first attempt to integrate a diagnostic whole mixture assessment workflow based on in vivo toxicological profiling of Danio rerio after direct exposure to sediments from Gulf of Bothnia (Sweden) for 4 days. The objectives of the present study was to (1) to validate a screening approach for sediment of samples (2) to offer a first in vivo toxicological profile of sediment from three different polluted sites from Gulf of Bothnia.

52 Proteomics based screening tool to detect molecular responses following astatinization exposure S.U. Ayobahvan, IME Fraunhofer / Department of Aquatic Ecotoxicology; E. Eilebrecht, M. Teigeler, Fraunhofer IME / Ecotoxicology; M. Kothoff, Fraunhofer IME / Environmental and Food Analysis; S. Kalkhof, University of Applied Sciences Coburg / Department of Bioanalytics; C. Schaefers, Fraunhofer-Institut / Ecotoxicology; H. Hollert, RWTH Aachen University / Institute for Environmental Research UFZ / Department of Chemistry

Chemical exposure to endocrine disruptors can have adverse outcomes on organism health and function; however, the current reliance on end-points such as egg number, plasma VTG content and morphological changes to determine effects of endocrine disrupting chemicals has given rise to series of questions related to chemicals exhibiting similar effects but different mode-of-action (MoA). Identification of the biophysical mechanisms underlying similar effects of different MoA is crucial in order to predict adverse effects in species that are specific to chemical- induced apical responses in zebrafish. The study focused on fadrozole, a known inhibitor of cytochrome P450 aromatase. Thus an excellent model substance to evaluate and validate proteomic methods with the integration of organ-specific effects. Spawning adult zebrafish groups (5 males, 5 females) maintained at 25±0.5°C in 1 L, 68 h light cycle were exposed for 21 days to fadrozole (0.0, 0.1, 1, 10 µg/L) and analysed for plasma vitellogenin content, egg numbers and organ histopathology. Livers and gonads were isolated for shotgun proteomics and qPCR to characterize substance induced specific molecular toxicity pathways. Proteins involved in steroid hormone secretion and estrogen stimuli such as vtg1, vtg3, vtg6 and lman1, were significantly deregulated. Several of the prominently affected pathways involved regulation of xenobiotic stimulus, lipid metabolism, metabolic processes, TCA metabolism and calcium signalling. Our study demonstrated that the downstream induced-estrogen receptor suppression by aromatase inhibition triggered the downregulation of estrogen synthesis, which was assumed to induce the observed decrease in egg numbers and oocyte atresia with membrane folding in the ovary. We anticipate that this measurement method leads to the identification of reliable biomarkers to determine chemical-induced adverse outcomes of ecological relevance in order to avoid unnecessary extensive testing.

53 Zebrafish embryos are able to conduct complex bio transformation processes and identification of chemicals E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanalytical Ecotoxicology; B. Seiwert, Helmholtz Centre for Environmental Research- UFZ / Department Analytical Chemistry; S. Speer, Helmholtz centre for environmental research - UFZ / Dept. Bioanalytical Ecotoxicology; S. Brox, Helmholtz centre for environmental research - UFZ / Department Analytical Chemistry; T. Reemtsma, Helmholtz Centre for Environmental Research / Department Analytical Chemistry; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology

Zebrafish embryos are proposed and partially already used as replacement for tests with (adult) animals conducted for human and environmental hazard assessment. This study has been concerned to perform a validation and efficiency assessment, which could interfere with prediction of adverse effects for safety assessment. The concern was provoked by anecdotal observation of the lack of activation for some compounds leading to a weak acute toxicity in fish embryos. However, internal concentration profiles of parent compounds suggest that fish embryos are principally capable for metabolic transformation of chemicals (Kühner et al., 2013, Environ. Toxicol. Chem. 32, 1819–1827). In order to assess the transformation more systematically we studied the biotransformation of two pharmaceuticals (clofibrate, celecoxib). Overall similar transformation products could be observed in zebrafish embryo as known from human studies. Interestingly, the ratios of the different products in fish embryos seemed to be different from the ratio in humans. Biotransformation is of particular relevance for compounds that require (metabolic) activation to elicit their intended biological effect or where activation “accidently” produces more toxic substances. Organophosphates (OP) can serve as a model compounds for a proof of concept for activation in fish embryos as in many cases activation is mediated by cytochrome P450 oxidation. Therefore, we studied the
activation of organophosphates by comparing the inhibition of acetylcholinesterase (ACHE) activity for the parent compound and the oxon-metabolite in homogenates and intact embryos. For homogenates only the oxon metabolites were able to provoke ACHE inhibition in a concentration dependent manner. In intact embryos inhibition was also found for the parent compounds. The inhibition EC50 was gradually reduced in later stages of embryos, if 24h exposure intervals for different stages were compared. The findings suggest that fish embryos are principally able to activate organophosphates and potentially also other compounds that later embryonic stages may exhibit advanced biotransformation capacity.

54 Differing PM2.5 Filter Extraction Methods: Impact on Chemical and Toxicological Analyses
C. Roiper, Oregon State University / Department of Environmental and Molecular Toxicology; S. Simonich, Oregon State University / Depts of Chemistry and Environmental Molecular Toxicology; R.L. Tanguay, Oregon State University / Sininhuber Aquatic Research Laboratory and the Environmental Molecular Toxicology

Toxicology research is essential to improve the understanding of the global public health burden of fine particulate matter (PM2.5) exposures. However, research groups using differing filter extraction methods to prepare PM2.5 and the potential toxicity bias from different extraction methods is rarely considered, possibly eliminating inter-laboratory comparisons and misrepresenting the toxic responses to PM2.5 constituents. To determine the impact of filter extraction methods on chemical constituent recovery and toxicity outcomes we took equal portions of a single high-volume PM2.5 filter sample collected in Riverside, CA. Each filter portion underwent a different extraction method (n=6) and recovered PM2.5 was then prepared for developmental toxicity testing by collecting the soluble fraction from DMso extraction. Zebrafish (n=32treatment) were treated with controls (DMSO, blank filter portions) and treatments (PM2.5/filters portion undergoing filter extraction) starting at 6 hours post fertilization. Aliquots of these PM2.5 solutions were used for chemical constituent analysis of polycyclic aromatic hydrocarbons (PAHs, n=120) and elements (n=20). Significant increases in mortality were observed for PM2.5 from 5 of the 6 filter extraction methods when compared to both the DMSO and blank filter controls. Combined mortality and morphological changes were significantly increased following PM2.5 treatment in all extraction methods compared to DMSO controls. Importantly, two of the methods showed significant mortality and morphological changes with blank filters when compared to DMSO controls. Chemical analysis is underway and differences in PM2.5 solutions between extraction methods will be investigated. Correlations between chemical components and developmental toxicity outcomes will identify components that are driving mortality and potentially altered during specific extraction procedures. This research highlights the toxicity bias due to PM2.5 filter extraction methods that must be considered when conducting research with complex ambient mixtures. Ultimately, this work identifies extraction procedures for use in this cost-effective surrogate to compare the inherent toxicity differences of PM2.5, and provides a path that will ultimately promote improved understanding of PM2.5-associated health effects.

Safeguard and Conservation of Cultural Heritage: the contribution of chemistry

55 Cultural Heritage and Climate Change: impact and adaptation
C. Sabbioni, CNR-Istituto di Scienze dell’Atmosfera e del Clima

Cultural heritage, which is a non-renewable resource, is a sector extremely complex for the diversity of materials, structures and systems. The access to citizens and visitors need to be favoured, but at the same time, it is our responsibility to transmit cultural heritage at European level. Research on the threats that climate change will have on cultural heritage includes cultural heritage in the value chain of sustainable development: the priority that faces the world today. Research on the threats that climate change will have on cultural heritage has not been specifically developed to preserve such elements. Most products commonly employed in the restoration and conservation of cultural heritage materials have not been specifically developed to preserve such elements. In this lecture, I will review the most meaningful achievements of my group in this field. We have developed an innovative sol-gel route for preserving Cultural Heritage building materials. Specifically, a surfactant-assisted sol-gel synthesis to produce, in-situ on the building, crack-free nanomaterials to be used as long-term consolidants. Additionally, hydrophobic, water-repellent, self-cleaning, and biocidal properties can be incorporated into the product by innovative chemical modifications of the proposed synthesis route. Finally, I will summarize the future challenges of our group related to conservation of historic concrete in the framework of the Horizon 2020 project “InnovaConcrete”.

57 Towards the European Research Infrastructure in Heritage Science: E-RIHS
L. Pezzati, CNR-Istituto Nazionale di Ottica

The European Research Infrastructure for Heritage Science (E-RIHS) entered the European strategic roadmap defining the future research infrastructures (ESFRI Roadmap) in 2016, as one of the six new projects. E-RIHS support research on heritage interpretation, preservation, documentation and management. Both cultural and natural heritage are addressed: collections, buildings, archaeological sites, digital and intangible heritage. E-RIHS is a distributed research infrastructure with a multi-level star-structure: facilities from many countries will be organized in national networks, coordinated by several national hubs and an RIHS headquarters will provide the unique access point to all E-RIHS services, by coordinating the net of National Hubs.

58 Discussion & Conclusions

Modelling and monitoring of pesticides fate and exposure in a regulatory context (II)

59 Scenario Development for Off-field Soil Exposure and Risk Assessment
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In its Scientific Opinion on risk assessment for in-soil organisms EFSA proposes a preliminary approach for off-field soil exposure by adding up entries from the different major exposure routes. EFSA indicates the worst-case character of its scenario “In the absence of appropriate off-field exposure scenarios…”, and hence, emphasises the necessity for model and scenario development. The present work aims to undertake first steps (i) to develop a model approach for off-field/field-crop soil exposure due to runoff, erosion, and drift, (ii) to develop exemplary schematic and real-world scenarios, (iii) which allow to gain insights in off-field soil exposure and risk using case studies. The developments are based on the Specific Protection Goals options. A tiered modelling approach is presented which allows to build exposure-scares ranging from simple schematic and conservative to more realistic landscape-scale tiers, which can be easily linked to effect modelling (toxicological, population, community). Results are intended to support the design of off-field soil exposure and risk characterisation scenarios and the development of assessment endpoints relevant to address SPGs.

60 Biogenic residues formation from pesticides - an overview
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Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in major amounts to nearly all compartments of the environment. Soils and sediments as complex matrices provide a wide variety of binding sites and are the major sinks for these compounds. Pesticides entering these complex systems may undergo various turnover processes. They can be degraded chemically (e.g. photolysis), biodegraded by microorganisms, or volatilised leached to the groundwater or taken up by living organisms or immobilised in the form of non-extractable residues (NER). Microorganisms can use C and N from a pesticide to synthesize their biomass compounds, e.g. amino acids (AA) and fatty acids (FA). The extraction of known microbial biomarkers from soil or sediment after addition of C and N isotope tracer allows an estimation of microbial activity in the transformation of pesticide. We investigated the turnover of biogenic residues (2,4-D, glyphosate, metamitron, bentazon, bromoxynil and clodinafop-propargyl) with the particular focus on the metabolic incorporation of the isotope label into AA, FA and their fate over time. An agricultural soil and water-sediment were incubated with stable isotope labelled for off-field soil exposure and risk exposure endpoints relevant to address SPGs.

14 SETAC Europe 28th Annual Meeting Abstract Book
After foliar application, plant protection products (PPP) undergo several routes of dissipation of which one is precipitation-induced wash-off from the canopy. This process is accounted for in the European exposure assessment framework for PPP authorization and included in the corresponding numerical models, e.g. FOCUS PEARL, HELIO, PRZM and MACRO. A numerical wash-off factor for modelling is applied, quantifying the wash-off from plant surfaces by a given amount of precipitation. Consequently, this factor is relevant for the calculation of predicted environmental concentrations (PEC) for the compartments soil, groundwater, and surface water. In case a measured wash-off factor is not available, a default value is to be applied. An increase of this default value from 0.5 cm⁻¹ to 1 cm⁻¹ has been proposed by EFSA, which results in more exhaustive wash-off from the plant surface. Generally, the extent of rainfall-induced displaced substance depends on several factors. An ECPA Working Group recommended a harmonized experimental approach to derive wash-off factors in the greenhouse: a 24th time interval between pesticide spraying and 10 to 20 mm of artificial rain, followed by an extraction of the plant material with an acetonitril/water mixture of 80:20 (v/v). This standardized experimental procedure has been defined in order to derive a reliable numerical wash-off factor as input for FOCUS modelling. In this study, the performed literature was reviewed for the availability of data suited for the calculation of a wash-off factor, reflecting a variety of different investigation types in terms of time of (artificial) rainfall after application, rainfall amount and intensity, formulation, crops under investigation, etc. Published experimental wash-off studies are usually not conducted according to the standardized experimental procedures. Thus, only a limited number of the published studies are suitable to derive a wash-off factor for modelling. The outcome of the literature review presented herein suggests that a meaningful default wash-off factor should be well below 1 cm⁻¹. Keeping the existing default value of 0.5 cm⁻¹ retains a sufficient protection level while at the same time avoids a large number of unnecessary refinement studies.

62 Application of a dynamic aquatic food web model for FOCUS exposure assessment
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In a regulatory setting, the potential for bioaccumulation and biomagnification of plant protection product active substances in aquatic organisms is evaluated with simple screens on the basis of a substance’s log Kow, where typically a value greater than or equal to 3 indicates concern. However, this criterion may lead to false positive identification, because it does not account for biotransformation of the substance in the environment or bioavailability in the environment. Dynamic aquatic food web models are more refined tools for determining bioaccumulation and biomagnification potential, because they can account for chemical bioavailability and temporal and spatial variability in exposure concentrations due to seasonal or regional differences in weather and agricultural practices. The aim of this work is to demonstrate a modelling approach that couples standard FOCUS landscape and water body models with a dynamic aquatic food web model to assess whether a hydrophobic insecticide with log Kow above the screening threshold of 3 will bioaccumulate/biomagnify. The Simon Fraser University (SFU) aquatic food web model, which predicts chemical concentrations in biota at six different trophic levels within an aquatic ecosystem, was selected based on the availability of data for relatively few input parameters and its demonstrated capability to predict observed chemical concentrations for a wide range of species, chemicals, and aquatic environments. To maximize relevance for agricultural systems in Europe, the food web model was adapted to accept environmental concentration time series input from the established TOXSWA model used in EU pesticide registration procedures. The modelling approach leveraged the transient form of the aquatic food web model and the time varying nature of biotransformation and wash-off from plant models. Modelling results included both the daily time series predictions of organism concentrations for the six trophic levels and the uptake and elimination rate constants calculated from organism sub-models. In total, nine FOCUS scenarios were simulated and compared (five drainage scenarios with MACRO and four runoff scenarios with PRZM) and dominant organism uptake pathways were identified. The approach may be used to refine log Kow-based screening bioaccumulation and biomagnification evaluations for regulatory purposes.

63 Improved assessment of pesticide peak exposure in cultivated mountain watersheds
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Agricultural activities can involve the use of plant protection products (PPPs) and the use of such chemicals can occur near surface waters bodies, thus creating a potential for adverse effects on aquatic ecosystems. Due to the spatio-temporal variability of chemical applications and of the processes regulating their fate and transport to surface waters, ecosystems are often exposed to pulses of contaminants. In recent years, environmental scenarios, such as small mountain watersheds, where runoff fluxes are particularly rapid due to side slopes, exposure peaks can be shorter but much higher. Monitoring campaigns are often inadequate or too expensive to be carried out and modelling tools are therefore vital for exposure assessment and their use is encouraged by current legislation. However, currently adopted models and scenarios (e.g., FOCUS for PPPs) are often too conservative and/or “static” to accurately capture exposure variability, and the need for more realistic and dynamic tools is now one of the major challenges for risk assessment. In a previous work, the new fate model DynAPlus was developed to improve pesticide fate predictions in cultivated mountain basins. The model was successfully evaluated against chlorpyrifos water concentrations measured in the Novella River (Non Valley, Northern Italy), where more than 1000 ha of apple orchards surround the river and the project SMARTCROP (funded by the Research Council of Norway), was started to address the challenges of developing and providing farmers with the necessary IPM tools. Towards this objective, SYNOPEX, a risk indicator developed by the Julius-Kühn Institut, Germany, was adapted for Norway and provided with a graphical user interface such that a farmer or non-expert could perform risk assessments for field-specific pesticide applications. US-ERA PRZM5 and VFSMCD have been incorporated in SYNOPEX for a more realistic modelling of the runoff/erosion modules and the functioning of the vegetated filter strip. The Norwegian tool, SYNOPEX-WEB, is available in both English and Norwegian. It uses Norwegian land-use, surface water and soil data, plant protection products registered for use in Norway, modified crop data for Norwegian conditions and station-specific data. Data from rainfall and erosion models were carried out for specific field and application scenarios. Another important new feature is the implementation of various mitigation measures such as vegetated filter strips, hedges, tillage/mulch, and cover crops. Risk assessments can be performed for a combination of mitigation measures in order to select the optimal application strategy under specific field conditions. In this presentation, we describe and discuss the mitigation measures implemented in SYNOPEX-WEB, Norway, and the corresponding adjustments to the model input parameters. We provide example scenarios based on realistic application patterns, without and with mitigation measures. Aquatic and terrestrial risk indices are presented to the user as Exposure Toxicity Ratios (ETR) in the form of colour-coded tables for an easy visual appraisal of the environmental risk under different conditions. In addition the predicted environmental concentrations can be viewed on a daily basis for the selected time period.
on their Environmental Fate and Effects (II)

65 Acute Toxicity of Pyrene Associated with Dissolved Organic Matter of Various Molecular Weights to Daphnia magna

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Dissolved organic matter (DOM) is a key environmental factor for the toxicity of hydrophobic organic compounds (HOCs) in natural waters. However, the toxicity of DOM-associated HOCs is still not clear. In this research, pyrene was selected as a model compound and its dissolved compounds (C_{DOM}) was measured by passive dosing systems. The immobilization and enzymatic activities of Daphnia magna were examined to analyze the toxicity of DOM-associated pyrene. The results indicated that the immobilization of Daphnia magna in the systems containing various molecular weight DOM and pyrene was ordered as middle molecular weight (MMW, 5-10K Da) DOM > higher molecular weight (HMW, > 100K Da) DOM > lower molecular weight (LMW, < 1K Da, 1-3K Da, and 3-5K Da) DOM. Furthermore, the superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD) activity of Daphnia magna decreased gradually with the increasing C_{DOM} in the systems of MMW and HMW DOM, whereas increased when C_{DOM} was at a low level and then decreased when C_{DOM} was at a higher level in the control group with pyrene only and the system of LMW DOM. The influencing dosing from the silicone rod has significantly influenced the toxicity of DOM-associated pyrene to Daphnia magna were related with the amount of pyrene sorbed on DOM, the uptake routes of DOM by Daphnia magna, and the desorption of pyrene from DOM in the gut of Daphnia magna. The findings obtained in this research suggest that the toxicity of DOM-associated HOCs should be taken into account for the eco-environmental risk assessment of HOCs in water systems.

66 Passive dosing for constant concentration and defined composition of hydrophobic organic mixtures

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There is regulatory and scientific attention on the fate, exposure and effects of chemical mixtures including complex mixtures of hydrophobic chemicals such as petroleum substances and essential oils. These mixtures have recently been categorized as multicomponent substances and substances of unknown or variable composition, complex reaction products or biological materials (UCVBs). The dosing of such mixtures in environmental experiments and tests can be challenging and there is an urgent need for new methods to provide stable concentrations and defined composition of these mixtures in aquatic fate and toxicity testing. Passive dosing from a silicone rod has successfully been used in biodegradation and toxicity testing of hydrophobic chemicals covering a broad chemical space in terms of K_{ow} and K_{oc}. This study aims to extend the applicability of the novel passive dosing method to hydrophobic multicomponent substances and UCVBs (i.e. complex mixtures). The method is straightforward: a silicone rod is loaded by direct addition of the mixture and subsequently equilibrated with ultrapure water to create constant and defined concentrations of each mixture constituent and thus also a constant and defined mixture composition. The aqueous concentration level can be controlled by the amount of mixture added to the rod. Early results show a good performance of the method with very fast dosing kinetics, aqueous concentrations increasing linearly with loading level and good reproducibility of the passive dosing for a petroleum substance and an essential oil. The presentation will focus on 1) the fast and reproducible loading of selected UCVB mixtures, 2) reproducibility and optimized passive dosing kinetics for one petroleum substance and one essential oil and 3) the performance and characteristics of the passive dosing method compared with more traditional dosing methods.

67 Biodegradation of volatile substances in soil - Challenges and optimization of test setups (OECD 307)


Higher tier biodegradation laboratory tests in soil, sediment and/or surface water systems are conducted using standard OECD guidelines. As stated in these guidelines, they are not suitable for testing volatile chemicals, however a threshold based on Henry’s law is not defined, except in OECD 309. In the actual setups, incomplete mass balance is a major problem while testing volatile chemicals. Optionally, OECD 307 and 308 allow biometer-type incubation setups but it does not require any data to prove if the systems remains aerobic. In addition, the degradation kinetics in a closed test system can largely be influenced by air-water partitioning as described by Birch et al. 2017. Our objective was to design a closed incubation test set up where maintaining and measuring of aerobic conditions was possible without the loss of test chemical. Additionally, a full scale OECD 307 with two model chemicals was performed to check the reproducibility of data in terms of mass balance and to better understand the obtained degradation data. The test setup consisted of 100 mL flask with 50g soil, CO2-trap and a Tenax tube completely closed using a stainless steel lock system. Oxygen saturation in the headspace was measured in a reference sample using optical measurements without the need to open the vessel. If the oxygen saturation was < 15%, the samples was aerated with oxygen-rich air. Applying this setup, degradation of 14C-labelled Tetradrin and Decane was conducted on four soils with different texture, organic carbon and microbial activity. At sampling dates the headspace air of the samples was stripped off through the Tenax tube using a vacuum pump. The Tenax tube and the CO2-trap were taken for analysis and the soil was taken for extraction using appropriate methods. The solid extraction residue was subject to combustion analysis to determine the non-extractable residues (NER). The average overall recovery of 99.29% (N=90) for Decane and 104.34% (N=90) for Tetradrin with a variation (between the individual replicates) < 11% for both studies suggests that obtaining a complete mass balance with the new test setup was reproducible. It was observed that radioactivity adsorbed on Tenax (100% parent), was higher in the soils with lower OC content suggesting that sorption of the chemical affecting its volatilization and hence degradation. Thus, how to deal with the volatilized parent fraction while calculating degradation kinetics is still a part of ongoing research.

68 Untangling the biodegradation of hydrophobic chemicals in OECD and novel tests using a unified modelling approach

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Persistence assessment using standardized (e.g., OECD) tests is one of the main challenges for hydrophobic organic chemicals (HOCs). While the use of radiolabeled chemicals brought major advances, mechanistic models can still provide deeper insights in experimental results and underlying processes. In this context, the key objective of this study was to test the applicability of a unified model approach across the spectrum of OECD degradation tests with newly developed experimental tests for HOCs. We specifically aimed at (i) elucidating biodegradation kinetics and improving their estimation by including a new method for microbial yield calculation; (ii) determining 14C fractions (mineralized, incorporated in biomass and non-extractable residue NER) at the end of tests as persistence indicators. The unified model for sorption and biodegradation (in combination with the Microbial Turnover to Biomass growth yield estimation method) was used to predict mineralization to CO2 growth of degrading microorganisms and NER formation in aerobic degradation tests with selected 14C-labeled HOCs (triclosan, pentachlorophenol — PCP, propargate and pyriproxyfen). Model predictions were fit to experimental results obtained elsewhere in conventional degradation tests activated sludge or soil in novel passive dosing setups, in order to distinguish between (i) the formation of intermediate transformation products; (ii) determining (de) sorption limitation based on dedicated experiments; and (iii) using uncertainty-based approaches to support decision makers within REACH.

69 History of polychlorinated biphenyl deposition to snow and ice from the Lomonosovfonna glacier on Svalbard from an ice core drilled in 2009, and a snow evolution model of polychlorinated biphenyls and derivatives

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Polychlorinated biphenyl (PCB) deposition to the north polar regions has long been recognized. Here we investigate quantitative and qualitative PCB inputs to the Lomonosovfonna glacier on Svalbard from an ice core drilled in 2009, and a snow pit from snow from spring 2010. Lomonosovfonna is the highest-elevation ice on Svalbard at 1250 mst. It is above the tropospheric boundary layer at all times of year (maximum ~1000 mst), so all of the contaminant inputs has source from long
distances, and do not include any local PCB sources on Svalbard. Total PCB deposition history to the core and surface snow shows that amounts have not declined in net amount since the mid 1950s. The peak flux in the surface snow and to ice core layer is 18.5 - 19 pg cm-2 yr-1. Average 5-day air mass back trajectories from peak flux periods beginning in 1998 show more frequent 5-day air mass trajectories from Russia, and from Europe south of 600 N latitude, particularly extending into the U. K., relative to 1989-1998, which had 5-day trajectories ending in the far north of Russia and Norway. The surface snow PCB contamination profile is dominated by PCB 110, 74, 70, 101, 95, 11. Combined, these five congeners represent ~27% of PCB. The upper-most ice core sample is dominated by PCB 95, 52, 101, 110, 74, which represent ~42% of PCB. The most apparent difference between the two profiles is the lower amount of dichloro- and trichloro- congeners in the surface snow profile. The indication is that the more volatile congeners in the dichloro- and trichloro- homologues are deposited to surface snow shown in Figure 1A, but are volatilized back to the atmosphere during periods of higher summer air temperature. The percent of PCB-111 throughout the samples ranges from 0.90-3.4% and is present in all samples dating from 1957. It is the dominant congener among mono- and di-chloro PCBs. This PCB congener has very low or no presence in Arctic Ocean products, and apparently is not found in other PCB parent mixtures. Its source is often considered to diaryl yellow pigment or products containing it. Its presence in the environment is sometimes associated with disposal of products containing this pigment. The source of PCB-11 to Lomonosovfonna is uncertain, but could be waste incineration facilities in Europe where it has been found in flue gas.

70 Environmental occurrence and distribution of organic UV stabilizers in the sediment of the Bohai and Yellow Seas C. Apel, Helmholtz-Zentrum Geesthacht; J. Tang, Yantai Institute of Coastal Zone Research, CAS; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry, Germany

Organic UV stabilizers are of emerging environmental concern due to their large production volumes and potential endocrine disrupting properties. UV stabilizers are widely used in plastic products, paints and coatings to improve the product stability against UV light. Furthermore, some UV stabilizers are approved as ingredients in personal care products like cosmetics and sunscreens. The pathways into the marine environment are either indirect by wastewater treatment plant discharges or direct by recreational activities like bathing and swimming. Four benzotriazole UV stabilizers are classified as SVHC (Substances of Very High Concern) under the EU legislation REACH. Numerous others are currently listed under the European community rolling action plan (CoRAP) to be (re-)evaluated in the near future. Due to their chemical properties, most UV stabilizers accumulate in sediment (logKow > 3) and have potential for persistence or pseudo-persistence. Environmental data for the coastal and marine environment are sparse. For this study 74 surface sediment samples of the Bohai and Yellow Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as follows: First, the samples were homogenized with sodium sulphate. Afterwards, extraction and clean-up was performed using an accelerated solvent extraction (ASE-350, DIONEX, Germany). For this, 22 mL stainless steel ASE cells were filled with 3 g of 10% deactivated silica and approximately 5 g sediment that was spiked with appropriate isotopically labelled standards. The cells were extracted using dichloromethane for three 15 min-cycles at 100 °C. The extracts were solvent-changed to methanol, reduced in volume to 150 µL. The isolation of the UV stabilizers was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadrupole LC/MS, Agilent Technologies, Germany) equipped with an APPI-source and a C18 column (Eclipse Plus RRHD 1.8 µm, 2.1 x 150 mm, Agilent Technologies, Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the Bohai and Yellow Seas for the first time. 14 substances have been positively detected in concentrations in the low ng/g dw range. Characteristic pollution profiles and distribution pattern have been identified, which indicate to different indirect sources of UV stabilizers into the study area.

LCA method developments in a global perspective: Status and outlook (I)

71 Implications of spatial differentiation on LCA-based decision-making: a case study of biochar systems in Indonesia M. Owismiak, Technical University of Denmark; G. Cornelissen, S. Hale, Norwegian Geotechnical Institute; H. Lindjem, Menon Economic; M. Sparerick, NTNU

The development of spatially differentiated life cycle impact assessment (LCA) methods and their use in regionalized life cycle assessment (LCA) has intensified in the past few years. However, it is less investigated whether spatial differentiation leads to more correct decisions based on the LCA, in addition to just more accurate and realistic LCA results. The aim of this study was therefore to assess the implications of spatial differentiation on the interpretation phase of a comparative LCA. Biochar production from biomass residues and its use as soil conditioner in Indonesia was used as case study. Comparisons were made between 4 villages, 3 biochar production techniques, and 2 fertilization strategies. Results showed that (i) regionalized impact scores for individual impact categories either increased or decreased compared with site-generic scores, depending on the impact category (by up to 1 order of magnitude); (ii) total damages to human health were approximately 3 to 5 times higher when compared to site-generic scores and (iv) irrespective of the geographic locations, regionalized data demonstrated the occurrence of trade-offs between categories, where increase in impact scores for some categories was compensated by decrease in others. Overall, irrespective of the approach to spatial differentiation in LCIA, biochar production and use in agriculture is generally expected to bring environmental benefits. When parameter and inventory uncertainties were considered, there was not much variation, but differences were still very much in favor of best performing villages in terms of total damage to human health and ecosystems; although village performing worst with regard to total damage to human health changed. There was a general tendency that biochar production using both Kon Tiki and Adam retort kilns performed better than earth-mound kiln, and furthermore biochars brought largest benefits where no-biochar agricultural production systems were based on inorganic fertilizers. This rather consistent ranking was mainly due to relatively large geographic differences in life cycle inventories between villages, which were often larger than geographic differences in characterization factors between specific and site-generic approaches. Thus, although spatial differentiation improved accuracy and realism of environmental impacts in this comparative case study, it did not necessarily contribute to more correct decisions.

72 Considering space debris related impacts within the LCIA framework T. Maury, University of Bordeaux / ISM-CyVi; P. Loubet, CyVi-ISM / ISM CyVi; A. Gallice, ArianeGoup / Design for Environment; G. Sonnemann, University of Bordeaux / ISM CyVi

The space sector is a new area of development for LCA studies. The European Space Agency (ESA) has been working since 2012 on environmental issues for space activities through its Clean Space Initiative. ArianeGroup, which is the prime contractor for the development of the new Ariane 6, is currently performing an LCA of this launcher in exploitation phase (ESA’s contractual requirement). However, the current studies adopt a Cradle-to-Launch pad approach due to lack of relevant modelling for use and disposal phase. In addition, a rising sustainability concern is occurring in the space sector particularly regarding impact of space debris; 29,000 human-made objects, larger than 10cm, are orbiting the Earth but only 6% are operational spacecraft, being today a significant and constant danger for all space missions. Consequently, considering end-of-life management during the design of orbital missions becomes a sustainability concern.

Given this situation, there is an opportunity to make the link between space debris concern and eco-design of spacecraft (satellites & launchers) using the LCA methodology. A focus should be put on the comparison of several missions & post-mission disposal scenarios to study potential trade-offs between typical impact categories (e.g. toxicity and climate change), but also with regard to the growing issue of space debris. Hence, our challenge is to integrate, via a dedicated additional indicator, space debris related impacts within the LCIA to broaden the scope of LCA for space systems. The Area-of-Protection Resources has been identified to reflect the depletion of available orbits by the potential generation of space debris. Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s design. Volume occupancy by debris and dead spacecraft leads to a decrease of the orbital resource availability enhancing the risk of collision/break-up and then propagation of new clouds of debris. As a consequence, the lack of access to the orbital resource in the future (scarcity) could be handled as environmental and socio-economic impacts. The presentation will prove the relevancy of this approach by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.

73 Implementing ozone formation effects due to poplar plantations for biomass production in Europe in the IMPACT 2002+ approach P. Vercoulon, Radboud University; R. Kranenborg, C. Hendriks, TNO; R. Van Zelm, Radboud University / Department of Environmental Science

Poplar trees are known to emit volatile organic compounds, among them isoprene, which enhances tropospheric ozone formation. Ozone exposure, in turn, causes adverse effects to human health and ecosystems. In the context of an energy transition, it has been proposed to use poplar biomass for the generation of biochar for the long-term carbon storage and of electricity. The goal of this research was to determine country specific characterization factors (CFs) for ecosystem damage due to ozone formation from isoprene emissions caused by poplar tree plantations in Europe. CFs were defined as the change in potentially affected fraction of plant species (PAF) due to a change in the country-specific poplar plantation area (in km²), and consists of a fate factor and an effect factor. To determine the fate factor, changes in Accumulated Ozone over a Threshold of 40 ppb (AOT40) in all grid cells connected to isoprene emissions resulting from additional poplar plantations on 1% of agricultural land in each country were estimated with chemistry transport model

SETAC Europe 28th Annual Meeting Abstract Book
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (II)

K. Bester, Aarhus University / Environmental Science; M. Escolà Casas, Aarhus University / Department of Environmental Sciences; U. Bollmann, Aarhus University / Environmental Science; P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; E. Toretti, Kruger A/S; H. EI-taliawy, Aarhus University / Department of Environmental Science; L. Zhang, Aarhus University / Department of Bioscience; G. Ooi, K. Tang, DTU Environment; H.R. Andersen, Technical University of Denmark / Department of Environmental Engineering; M. Christenson, Anox Kaldnes Pharmaceuticals and other compounds need to be removed from wastewater. This contribution will give an overview on the possibilities of removing micropollutants with biofilms. Biofilms occur in nature, but are also increasingly used in technical installations to remove micropollutants from water (wastewater and drinking water), porous media biofilm systems (sandfilters), moving bed biofilm systems (MBBRs). Biofilms can remove considerably better than suspended bacteria: diclofenac is recalcitrant in sludge systems, while it can be degraded with half-lives of 2 h in biofilm systems. In this contribution it is highlighted which ecological conditions (aerated versus denitrifying; high and low BOD loads) have been found to favor degradations. It was found that BOD supply has massive impact on the removal: On the one hand high BOD loads led to enhanced growth of biofilm, resulting in high turnover and reaction rates also of the respective micropollutants. On the other hand the biomass related reaction rate constants are considerably higher with low BOD loads. The highest reaction rate constants and biomass related reaction rate constants were found for systems with intermittent BOD loading. The switch from aerated to denitrifying conditions, however, only gives effects for a chosen few compounds like ibuprofen, while reaction rates usually are similar. So the redox conditions as such are obviously not critical. Biofilms have often proven to have unique degradation pathways leading to hitherto strange metabolites. On the other hand compounds that were thought to be recalcitrant (like diclofenac) could easily be degraded in relatively short time periods. For single compounds degradation pathways for biofilm systems are discussed and compared to other systems. – While oxidation pathways are relatively common it seems like biofilms often perform a combination of oxidation and sulfatation pathways. Interestingly enough, it is possible to reach high removal rates for otherwise persistent ozonation-by-products such as macrolide N oxides while avoiding back reactions to the parents with a moving bed biofilm reactor (MBBR). This also holds for most of the ozonation products of diclofenac.

78 Biodegradation of emerging organic contaminants using an enzyme-mediator system and study of the resulting transformation products

I. Caraene, Curtin University / chemical department; C. Joll, Curtin University / chemical department; K. Linge, Y. Gruchlik, Curtin University; A. Paparini, Murdoch University
Due to improvements in analytical screening methods, a large number of emerging organic contaminants (pharmaceutically active compounds, personal care products, pesticides, surfactants, plasticizers, corrosion inhibitors, flame retardants, artificial sweeteners and others) have been identified in the aquatic environment. Biodegradation is one of the processes that can remove potentially hazardous emerging organic contaminants from different environments, with the help of microorganisms (e.g., algae, bacteria or fungi) and their extracellular products, in both aerobic and anaerobic conditions. The objective of this study was to investigate the biodegradation of a series of antibiotics and one antiviral compound using laccase enzyme, extracted from a white-rot fungi Trametes Versicolor, in the presence of 2,4’diazobis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS), as a mediator. The experiments were conducted in MilliQ water at different pH values, with different ratios of laccase and mediator, under aerobic and static conditions. The degradation was monitored by measuring the concentration of the remaining antibiotic over 168 hours, using a high performance liquid chromatograph with UV detection. The formation of new peaks was also monitored.
and high resolution mass spectrometry (HRMS, LTQ Orbitrap) was used to identify potential transformation products. Furthermore, the microbial activity of the antibiotics and their transformation products was assessed, using an E. coli culture and microbial disks. Results showed that 89% degradation of sulfamethoxazole can be achieved at pH=5, with an enzyme activity ranging between 110-120 U/L and an initial mediator concentration of 200 µM, while trimethoprim only degraded by 43% under the same conditions. The results of similar sorption experiments on other antibiotics will be discussed in this conference presentation.

The identification of transformation products of the antibiotics using high resolution mass spectrometry, and the microbial activity of the transformation products, will also be presented. This study provides a better understanding of the biodegradation of emerging organic contaminants and their transformation products. Further work could focus on assessing the possible health and environmental risks associated with the reuse of treated wastewater, for applications such as irrigation and groundwater replenishment.

79 Evaluation of macroalgae antibiotic transformation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays S. Terzic, Rudjer Boskovsk Institute / Division for Marine and Environmental Research; P. Kostanjevecki, I. Krizman-Mataća, I. Senta, Rudjer Boskovsk Institute; T. Jurina, Faculty for Food Technology and Biotechnology; N. Udikovic-Kolic, Rudjer Boskovsk Institute; J. Ćurko, Faculty of Food Technology and ERY TPs was comparatively much lower either under biotic and abiotic removal of all parent compounds. The biotic and abiotic removal of all parent compounds as well as the formation of transformation products (TPs) were followed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. Antibiotic activity test was based on the inhibition of bacterial growth (Bacillus subtilis), while toxicity test was performed with the freshwater green algae Desmodesmus subspicatus. At the applied experimental conditions, both biodegradation and ozonation experiments resulted in nearly full elimination of the tested parent compounds. The biotic and abiotic removal of all parent compounds was associated with the formation of different TPs, some of which were rather abundant and persistent to further degradation. The highest number of detected TPs was associated with the elimination of AZI, while the number of CLA and ERY TPs was lower. The capability of the tested biodegradation microbial communities to transform antibiotic and abiotic conditions. The environmental relevance of the identified biotransformation products, some of which included previously unknown linearized TPs, was proven by screening the municipal wastewater extracts for their presence. The effect-driven evaluation of the studied transformation processes, based on toxicity to algae and residual antibiotic activity, indicated a significant reduction of harmful effects, however, formation of numerous stable transformation products, warrants further ecotoxicological assessment.

80 DI-SPME - On-fiber Derivatization - GC-MS. An innovative green and cost-effective approach to determine CECs and TPs from a novel anoxic-aerobic photo-bioreactor R. López-Serna, University of Valladolid / Chemical Engineering and Environmental Technology; E. Posadas, P.A. García-Encina, R. Muñoz, University of Valladolid The demand of multicomponent methods for the analysis of compounds of environmental concern has increased in recent years. Constructed wetland systems (CWs) have, however, been shown to be able to degrade some of these emerging contaminants, namely organic micropollutants. But the processes at the core of the removal of these compounds in CWs are yet unknown. Research being developed at Aarhus University aims at understanding the removal processes and fate of organic micropollutants in different types of CW systems. Five different experiments have been conducted in biofilm microbial community function. The plants Typha latifolia and Phragmites australis were the most efficient plant species in removing ibuprofen and iohexol. Phragmites was the most efficient species to remove the pesticides tebuconazole and imazalil. Uptake, translocation and degradation of chiral pesticides inside the
plant tissue was documented. Formation of transformation products was assessed, but the mass balances were not close. Organic micropollicants sorption to support matrix was low. Removal of different compounds was higher in summer than in the winter. Planted reactors showed higher efficiency than unplanted reactors, stressing the synergies between the plant and the microbial community. Unsaturated systems tended to be more efficient. Removal correlated with the nitriication activity and with plant biomass, suggesting that ERDOs play an active role in the micropollicants biodegradation. The removal of the organic micropollicants in CWs is affected by several design and operational parameters. Plant uptake does occur but phytoaccumulation is low as the compounds can be degraded inside the plant tissues. Due to overlying effect of the plants, the extent of microbial degradation could not be quantified. Further studies on transformation products in this type of technical systems are needed.

Wildlife ecotoxicology: laboratory dosing studies to field population assessments (II)

83 Effects of PAH exposure on fuelling ability in a long distance migratory shorebird

K. Bianchini, University of Saskatchewan - Toxicology Centre / Toxicology: C.A. Morrissey, University of Saskatchewan / Biology

Many shorebirds are long distance migrants that stop to refuel along the journey where they can be exposed to pollutants that may impede fuelling for migration. Exposure to organic pollutants can cause potential effects on migration success, speed and subsequent population parameters since pre-migratory fuelling is correlated with reproductive performance upon reaching the northern breeding grounds. The polycyclic aromatic hydrocarbons (PAHs) found in marine oil pollution have the potential to interfere with pre-migratory fuelling physiology in shorebirds. However, a link between PAH exposure and pre-migratory fuelling has yet to be established. Our objective was to determine if PAHs or associated contaminants can affect condition and fuelling rates in a captive shorebird, the Sanderling and in the field at major shorebird stopovers. In this study, a captive population of 49 Sanderling (Calidris alba) was orally dosed with a commercial PAH mixture for 21 days (http://www.sanderling.com). We found that PAH exposure was significantly elevated in the high dose group relative to controls and fuelling rates and condition were also lower in dosed birds. Higher PAH exposures were associated with reduced seed bile acid concentrations, elevated serum creatine kinase concentrations, and with high serum lipase concentrations (in females). These results suggest that PAH exposure can interfere with lipid transport and metabolism and can cause muscle damage leading to poorer condition. We also captured Sanderling from the Gulf of Mexico, which is subject to recurring oil spills and from Chaplin Lake, Saskatchewan, a relatively uncontaminated site. We measured each bird’s body condition, fuelling status, and plasma PAH levels and attached miniature radio transmitters to a subset of birds (n=75). Motus radio telemetry array technology was used to determine the arrival and departure timing and stopover duration. We found that mean stopover durations in the Gulf of Mexico were longer than in Chaplin Lake (27 versus 15 days), and that stopover duration was associated with body condition and fuelling status at capture. We also measured higher plasma PAH concentrations in birds at certain Gulf sites, suggesting that PAH exposure is associated with lower pre-migratory fuelling rates. This work will inform shorebird conservation by providing valuable insight into a potential cause of migratory shorebird declines.

84 PFAs levels, oxidative status and reproductive success in great tits (Parus major) inhabiting a contamination hot-spot.

A. Lopez-Barbudo, University Autonoma / Physiology, T. Groffen, Systemic Physiology and Ecotoxicological Research (SPHERE), University of Antwerp / Biology; L. Bervoets, University Autonoma, R. Lasters, E. Prinsen, H. Abd Elgawad, University Antwerp; M. Eens, University of Antwerp / Department of Biology

Perfluoroalkyl acids (PFAs) are substances which have been produced for more than 50 years. Their unique properties of repelling both water and oil, make them suitable for many industrial and consumer applications such as water and dirt repellents for clothes and carpets, active components in firefighting foams or precursors in Teflon® production [1]. Its extensive use, together with their high persistence, has resulted in global contamination of the environment, wildlife and even humans [2,3]. This ubiquity contrasts sharply with the limited amount of available information on their effects in the environment. We report here PFAs egg and plasma levels in wild populations of great tits (Parus major) settled along an established pollution gradient starting from a fluorochemical plant in Antwerp (Belgium). Using two generations of great tits we have obtained important results in some poorly known issues such as the differences between sexes, maternal transfer of compounds or possible effects on the oxidative status or the reproductive success. The levels we detected in eggs and plasma, demonstrate that Antwerp is one of the major hot-spots in the world for perfluorinated compounds pollution. With regard to the possible effects, negative correlations were observed between PFAs levels in the eggs and reproductive parameters, including the total hatching success, eggshell thickness or the total breeding success. PFAs levels in blood correlated with protein damage in adult birds while in chicks they correlated with higher activity of antioxidant enzymes (GPX and CAT). The obtained data represent an important step towards the understanding of the behaviour, effects and consequences of PFAs in wild bird populations. [1] Buck RC, Franklin J, Berger BM, Franklin JM, Cousins AM, de Voogt P, Jensen A, Kannan K, Mabury SA, Van Leeuwen SP (2011). Perfluorooctyl and perfluorooctanoic acids in the environment: terminology, classification, and origins. Integ Environ Asses Manag 7: 531-541. [2] Giesy JP and Kannan K (2001). Global distribution of perfluorooctane sulfonate in wildlife. Environ Sci Technol 35: 1339-1342. [3] Giesy JP and Kannan K (2002), Peer-reviewed: perfluorochemical surfactants in the environment. Environ Sci Technol 36: 146-152.

85 Active and passive monitoring of lead poisoning in birds of prey in Spain

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The ingestion of lead ammunition is the most important source of exposure to this metal in birds of prey, and consequences on their health are well-known. The objective of the present study is to improve our knowledge on the exposure to Pb in birds of prey in Spain by means of passive sampling. Here we present the programs based on Pb analysis in blood and liver of raptors and by the evaluation of the effects on their health by using non-destructive blood biomarkers. We have performed a passive monitoring by measuring blood Pb levels in birds of prey of 16 species found dead or sick in Spain between 2004 and 2017, but also an active monitoring by measuring blood lead levels in birds (n=196) using miniature radio transmitters in 18 different high-lead areas. A study on the role of Pb in genes involved in cholesterol biosynthesis, PCA metabolism, oxidative stress and immune function were also evaluated in the active monitoring by means non-destructive biomarkers. The active monitoring showed that some individuals of bearded vulture (1/3), Eurasian griffon vulture (87/118), Spanish imperial eagle (16/6) and red kite (1/18) presented elevated blood Pb exposure levels (>200 µg/dl). Passive monitoring revealed that the species with lead levels in liver associated with clinical poisoning (18-30 µg/dl) were cinereous vulture (1/3), Eurasian griffon vulture (2/228) and western marsh-harrier (1/3); and the species with clinical severe poisoning (>30 µg/dl) of Pb in liver) were Eurasian griffon vulture (19/228), red kite (1/129) and golden eagle (3/36). The study of biomarkers reveals a negative relationship between Pb retention in blood and Pb concentration in plasma. Microhematocrit was affected by Pb exposure, because elevated blood Pb levels were associated with lower Pb levels in blood and higher Ca:P ratio in plasma of birds. Carotenoid levels in plasma were also increased in birds with higher blood Pb levels, indicating a possible allocation of antioxidants in plasma to cope with adverse effects of Pb. The integration of active and passive monitoring permits to have a more complete risk assessment for this important contaminant. With these results, the active monitoring the elevated blood Pb levels (73.7% with >200 ng/ml) in field-trapped Eurasian griffons as found in previous studies, but also report a significant mortality (8.3% with >300 ng/ml d.w.) in Eurasian griffons and golden eagles with the passive monitoring.

86 Persistence of elevated p,p'-DDE levels and HCB-related protoporphyrin IX decrease in eggs of common kestrels from Tenerife (Canary Islands, Spain)

A. Buck, Instituto de Investigacin en Recursos Cinegéticos IREC CSIC-UCLM / Toxicology; J. Carillo, University of La Laguna; P. Camarero, IRECInstituto de Investigación en Recursos Cinegéticos; R. Mateo, IREC-CSIC-UCLM / Grupo de Toxicología de Fauna Silvestre.

Persistent organochlorine (OC) pesticides, including p,p'-DDE, have been banned in many parts of the world for more than 30 years, but they are still present in the top predators of terrestrial and aquatic food webs. The Canary Islands were one of the Spanish regions with the highest use of OC pesticides due to the intensity of its agriculture. A previous study published in 2002 showed a close relationship between the proportion of incubated eggs of the West Canarian common kestrel (Falco tinnunculus canariensis) from Tenerife Island showed elevated concentrations of p,p'-DDE (17.9 µg/g d.w.; equivalent to 4.9 µg/g ww). Here, we have monitored the levels of OC compounds (pesticides and polychlorinated biphenyls) in 40 unhatched eggs of West Canarian common kestrel from Tenerife Island collected between 2009 and 2016. We have confirmed the presence of the pesticides p,p'-DDE and the metabolite p,p'-DDE-3,4-OH (41% of total p,p'-DDE) in these pigments as biomarkers of organochlorine pollution in birds. Biomass, status and environmental conditions were recorded for each nest. Because the eggs were at different degrees of desiccation, the content was lyophilised in order to measure OC concentrations in dry and lipid weight of content. OC analysis was performed by extraction with n-hexane chloride methanol (1:1), evaporation (for lipid weight calculation) and resuspension in n-hexane, followed by four clean-ups with sulfuric acid and determination by GC-ECD. For porphyrin determination, eggshells were homogenized and extracted with acetonitrile:CH3CN (2:1) and then
analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; µg/g dw): p,p'-DDE, 152.2 ± 1.7; p,p'-DDT, 0.118 ± 0.020; PCBs, 0.459 ± 0.121; HCHs (hexachlorocyclohexane isomers), 0.021 ± 0.003; and HCB (hexachlorobenzene), 0.0042 ± 0.0004. p,p'-DDE levels have remained elevated for more than 20 years and these levels were statistically associated in generalized linear models with the surface of active and abandoned cropland in a 200 m-radius around the nest (+), distance from nest to urban areas and greenhouses (-), altitude (-) and year (highest in 2011). PCB levels were associated with distance from nest to roads (-) and altitude (+). The shell index was not affected by p,p'-DDE levels, but decreased with embryo development. Propothorphen IX was the only pigment in eggshells and its content was negatively affected by HCB levels in egg content.

87 Long-term increase in secondary exposure to anticoagulant rodenticides in European polecats in Britain K.A. Samsbury, University of Exeter / Environment and Sustainability Institute; R. Shore, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Crose, The Vincent Wildlife Trust; M.G. Perreira, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. Hankle, National Museums Scotland; R. McDonald, University of Exeter / Environment and Sustainability Institute As a result of legal protection and population recovery in Great Britain, European polecats (Mustela putorius) are expanding into areas associated with greater usage of second-generation anticoagulant rodenticides (SGARs). We analysed livers from polecats found dead (mostly road casualties) from 2013-2016 for residues of five SGARs. We related variation in residues to polecats traits (age, sex, provenance), to potential exposure pathways by analysing stable isotopes of carbon (δ13C) and nitrogen (δ15N) into whiskers, and to data collected from polecats in the period 1992-99. In all, 54 of 68 (79%) polecats from 2013-16 had detectable liver residues of at least one SGAR. Bromadiolone (71%) was the most commonly detected compound, followed by difenacoum (53%) and brodifacoum (35%). Liver SGAR residues did not vary with sex or with the season in which the polecats died. We found a positive association between occurrence of liver SGAR residues and δ15N values. Polecats in Britain feed predominantly on rats and rabbits and our findings are consistent with the concept that individuals feeding on rats (higher trophic level than rabbits) are more likely to be exposed to SGARs. Total SGAR liver concentrations were higher in polecats from arable than pastoral habitats, consistent with more intensive SGAR use on arable farms, and higher in western than eastern areas although the reason for this is unclear. Both number of compounds and total SGAR concentrations were positively associated with age, presumably due to the multiple sub-lethal exposures during an animal’s lifetime; older animals may thus be at most risk from poisoning due to progressive accumulation of liver residues. When we compared data for polecats from 2013-16 with those for polecats that died in 1992-99 and accounted for differences between studies in detection limits, we found that the rate of detection of SGARs in polecats in Britain increased 1.7 fold over the 25 year period. This increase was not restricted to newly re-colonised areas and suggests an increase in the risk to polecats from SGARs throughout their range.

88 Poster spotlight: MO035, MO036, MO083

Environmental risk assessment in time and space - new approaches to deal with ecological complexity

89 The threshold option, the recovery option and landscape modelling P. Thorbek, Syngenta / Environmental Safety; N. Galic, Syngenta / Environmental Safety; V. Forbes, University of Minnesota / Ecology, Evolution & Behavior Landscapes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the deliverable sub-lethal exposures during an animal’s lifetime; older animals may thus be at most risk from poisoning due to progressive accumulation of liver residues. When we compared data for polecats from 2013-16 with those for polecats that died in 1992-99 and accounted for differences between studies in detection limits, we found that the rate of detection of SGARs in polecats in Britain increased 1.7 fold over the 25 year period. This increase was not restricted to newly re-colonised areas and suggests an increase in the risk to polecats from SGARs throughout their range.

Environmental risk assessment in time and space - new approaches to deal with ecological complexity

89 The threshold option, the recovery option and landscape modelling P. Thorbek, Syngenta / Environmental Safety; N. Galic, Syngenta / Environmental Safety; V. Forbes, University of Minnesota / Ecology, Evolution & Behavior Landscapes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the deliverable sub-lethal exposures during an animal’s lifetime; older animals may thus be at most risk from poisoning due to progressive accumulation of liver residues. When we compared data for polecats from 2013-16 with those for polecats that died in 1992-99 and accounted for differences between studies in detection limits, we found that the rate of detection of SGARs in polecats in Britain increased 1.7 fold over the 25 year period. This increase was not restricted to newly re-colonised areas and suggests an increase in the risk to polecats from SGARs throughout their range.

90 Understanding risk - a better approach to reduce uncertainty M. Wane, WSC Scientific GmbH / Dept E fate Modelling; M. Froudoulakis, Dow AgroSciences / RSRA ERS For many compounds the intrinsic toxicity as determined in toxicity studies does not reflect toxicity and risk adequately. Rather other mechanisms determine which species are most at risk (local species) and how large the risk posed to these species is. These include for example elimination rates and feeding behaviour, which are not considered in the first tier. In the present presentation results from two case-studies are given which demonstrate how uncertainty in the risk assessment can be reduced by trying to understand mechanisms that lead to toxicity and mechanism determining the actual and long-term risk of mammals and birds in the field. Field data help to verify the obtained knowledge and to determine an empirical margin of safety. Finally, population modelling is used to answer what-if questions and to answer questions on the relevance of effects when considering specific worst-case assumptions. In both example compounds metabolism and excretion together with feeding behaviour mainly determined the acute and long-term risk. All of these mechanisms are not considered in the first tier risk assessment and without these it would not be possible to understand the risk of the compounds shown here. This understanding significantly reduced the uncertainty of the risk assessment, because with the gained knowledge it is possible to identify critical scenarios.

91 Developing spatio-temporally realistic representations of agricultural landscapes for assessing the impacts of pesticides on non-target organisms E. Ziolkowska, Jagiellonian University / Institute of Environmental Sciences; C.J. Topping, Aarhus University / Department of Bioscience; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group Species richness and population sizes in agro-ecosystems have decreased dramatically during the last decades. The current scheme of agricultural intensification resulting in landscape simplification is considered one of the main causes of this biodiversity loss, along with widespread use of pesticides. As the management of landscape heterogeneity seems to be crucial for maintaining vital populations in agro-systems, it is necessary to include the landscape component in ERA and as the important mitigation strategy. We present a methodological framework for modelling spatio-temporal heterogeneity in agricultural landscapes. The framework it has been implemented within the ALMaSS simulation system allowing to investigate the effects of changes in landscape structure and management on population size and distribution of animals. We describe spatial landscape heterogeneity through a detailed land cover map, in which farmed areas are represented as accurate maps of fields grouped into farm units of different types (e.g., arable farms). The risk assessment and without these it would not be possible to understand the risk of the compounds shown here. This understanding significantly reduced the uncertainty of the risk assessment, because with the gained knowledge it is possible to identify critical scenarios.

92 Where are the Springtails? A vertical distribution model for Colembolans V. Roebeh, RWTH Aachen University / Institute for Environmental Research / Institute for Environmental Research BioV; L.S. Tschoppe, RWTH Aachen University / Institute for Environmental Research BioV; T. Preuss, Bayer Ag / Environmental Safety; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Ross-Nickoll, RWTH Aachen
University, Institute for Environmental Research / Institute for Environmental Research

With respect to environmental risk assessment it is crucial to know where and when to protect an organism but still little is known on the dispersal of collembolan communities in agricultural landscapes. Especially for the environmental risk assessment of plant protection products vertical movements can be relevant for exposure assessment of in-soil organisms. Thus, ecological modeling offers a powerful tool to link exposure to risk assessment. We will present the individual-based model of the soil-dwelling collembolan *Folsomia candida* FOLCAS (Folsomia candida simulation). FOLCAS is a vertical distribution model simulating an agricultural soil column, which can be applied to demonstrate the effect of variations in environmental parameters on the population and its dispersal. In addition, the model features the option to evaluate the effect of a pesticide application. The model consists of two submodels: the lifecycle and the movement submodel. The movement of the individuals in FOLCAS is influenced by temperature, pore space, pH and the organic matter as a proxy for food availability. In order to assess the importance of food availability as a main trigger for movement a vertical distribution experiment was designed. In this we assessed the vertical dispersal of *F. candida* in OECD soil in relation to food location and time. Transparent PVC columns were filled with 350 g OECD soil up to 20 cm column height and 86 individuals of *F. candida* of different age classes were added. Each column was divided in 6 compartments from top to bottom: 0-1cm, 1-2.5cm, 2.5-5cm, 5-10cm, 10-15cm and 15-20cm. The location of feeding was varied by four different regimes while all other parameters were kept constant (2°C, 20°C, 5% and 20% moisture). The dispersal under these regimes and simulation results of the vertical dispersal of collembolans will be presented. A case study will be used to elucidate the importance of the vertical dispersal of non-target arthropods in effect assessment.

93 A practical application of an individual-based stickleback model in the ERA of PPPs
K. Mintram, University of Exeter / Biosciences; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; S.K. Maynard, AstraZeneca / Safety Health and the Environment; A. Brown, Exeter University / Biosciences; C. Liu, University of Exeter / Environmental Sciences; S. Parker, Cefas Weymouth Laboratory; P. Thorbek, Syngenta / Environmental Safety.

Population models are employed in the environmental risk assessment (ERA) of chemicals, including plant protection products (PPPs), to extrapolate from individual-level effects to predictions of effects on whole populations. Individual-based models (IBMs) allow for the incorporation of individual variability, population-level interaction and specific behaviours. IBMs can therefore be used to extrapolate from a large number of individual-endpoints and simulate potential effects on populations under realistic environmental conditions. We present an IBM of the three-spined stickleback (*Gasterosteus aculeatus*) developed for the purpose of predicting population-level effects for exposure to chemicals. The IBM was developed from a series of sub-models parameterised with data obtained from experiments. Modelled population dynamics (e.g. size/age class distributions and annual fluctuations in population abundance) emerge from the adaptive traits, behaviours and interactions between individuals and their environment (including toxicant exposure). Here, we describe the development and validation of a stickleback IBM and demonstrate its practical application in ERA. Empirical data quantifying the reproductive effects and subsequent recovery, following exposure to a fungicide, were input into the IBM as a sub-model. Various exposure and recovery scenarios were simulated to predict population-level effects over time. The modelled outputs demonstrated that exposure duration and individual recovery post-exposure can influence the overall effects of chemical exposure on population abundance. We suggest that using IBMs to incorporate realistic exposure and recovery scenarios may improve current ERA and result in more realistic protection standards for wild populations.

94 Using the Bayesian network relative risk model to integrate molecular effects, ecological context and ecosystem services to estimate risk over space and time
M. Short, Western Washington University / Institute of Environmental Toxicology; J.D. Stark, Washington State University / Dept of Entomology; K. von Stallekberg, NEK Associates LTD / Department of Environmental Health; C. Mitchell, Washington State University / School of the Environment; V. Chu, Western Washington University / Environmental Science; M. Harris, Whatcom Conservation District / Institute of Environmental Toxicology; L. Wallis, Western Washington University / Institute of Environmental Toxicology.

An ongoing dilemma in risk assessment is the perceived difficulty in successfully integrating scales that range from the molecular to ecological, timeframe from days to decades, and endpoints that can be species specific to a host of ecosystem services. Starting In the late 2000s to now there has been an interest in defining ecosystem services and in the calculation of risk to these properties. It has been suggested that ecosystem services are a method to encourage a systems approach to sustainability. Human well-being has become part of the lexicon to included endpoints such as a sense of place, education, employment, public safety and traditional activities. In a recent publication (Harris et al. 2017) it was demonstrated that it is possible to estimate risk in a contaminated site to ecological endpoints, human health and ecosystem services using a clearly defined causal pathway and Bayesian networks. Now we are extending the integration of ecological endpoints, ecosystem services and human well-being from the scale of a contaminated site to that of the Salish Sea. The Salish Sea is a term applied to both the Puget Sound and its watersheds in the United States and the Straits of Georgia in Canada. Vancouver, Seattle, Tacoma, major ports, numerous refineries, paper mills, and high tech industries. The same area is also noted for intensive agricultural use, outdoor recreation and the harvest of marine resources. The region is also home to more than 30 recognized Tribes in the U. S. segment and First Nations in Canada. We will use three watersheds in this region, the Skagit, the Nooksack and the Cedar as case studies. Time frames will be from current conditions to 2070 and will include climate change projections for temperature and precipitation. We will demonstrate the application of the Bayesian-network relative risk model to integrate pesticide effects at the molecular level and the alteration of watersheds to calculate risk to the ecological endpoint Chinook Salmon, the specific economic ecosystem services provide by the endpoint and the watersheds, and finally demonstrate the risks to human well-being as defined from a variety of cultural perspectives.

The environment as a reactor determining fate and toxicity of nanomaterials (II)

95 Mobilisation of silver sulphide nanoparticles in soil column by earthworms’ bioturbation
M. Baccaro, Wageningen University / Toxicology Department; H.H. van den Berg, Wageningen University / Dept of Toxicology; D. Hermans, L. S loot, Wageningen University and Research; N. van den Brink, Wageningen University / Dept of Toxicology. The Ag2S-NP is the main product of transformation of Ag-NP in the waste water treatment plant (WWTP). In many European countries, sewage sludge containing Ag2S-NPs is applied on the soils as soil amendments. Earthworms are important ecological engineers in the soil ecosystem, which, on one hand, may be affected by Ag released from the amendments and, on the other hand, may influence the distribution of metals. Therefore, the aim of this study was to determine effects of Ag2S-NP application on an important earthworm driven process, i.e. bioturbation and the effect of the earthworm activity on the vertical distribution of Ag2S-NP in the top soil. Their interplay was assessed in two experiments, in presence or absence of artificial rain fall. Around 2 cm of soil treated with 10 mg Ag kg^-1 dry weight soil of Ag2S-NP (28.0±20.4 nm) was applied on top of natural soil columns (10 cm) mimicking an application of 200 Mg sludge ha^-1 dry weight. For the first experiment, columns were prepared with and without Lumbricus rubellus and with and without Ag2S-NPs. Every week for 28 days earthworms and four different layers of the soil columns (0-2, 2-4, 4-6, 6-10, 10-12 cm depth) were sampled. In the same way a second experiment was performed with daily application of 2 nm of artificial rain water, allowing collection of leakage samples from the bottom of the columns. Total Ag content was measured in all samples by ICP-MS following acid digestion and nano-Ag in leakage samples by sICP-MS. Results of the first experiment show that mobility of Ag along the soil column is significantly higher in the columns with earthworms overtime. Ag reached the bottom layer of the columns where worms were present while no Ag was found at the bottom layer of the column without worms. This indicates that earthworms do not avoid the contaminated top layer. Ag content in earthworms was relatively constant overtime with an average value of 1.06±0.32 mg Ag kg^-1 dry weight. The first study shows that uptake of Ag2S-NPs in earthworms occurred regardless of the partial exposure and points towards the crucial role of earthworm bioturbation in the mobilisation of metal nanoparticles in the top soil. The second experiment of the study is currently being performed, results will be presented at the meeting.

96 Short- and long-term approaches to determine the fate of silver nanoparticles in soil

SETAC Europe 28th Annual Meeting Abstract Book
Engineered silver nanoparticles (Ag ENP) are present in many consumer products. Hence, the ENP enter into sewers and wastewater treatment plants with a high predicted removal into the sludge. If the sludge is applied to agricultural soils, decompaction might result in resuspension of the ENP. The fate and impact of Ag ENP in soils is still unclear. Short- and long-term column remobilization experiments with disturbed soils, short-term column percolation experiments with undisturbed soils, and long-term field lysimeter experiments were conducted. All experiments were performed with sterically stabilized Ag ENP (AgNM-300k), and a slightly loamy Cambisol (RefSoil 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag_{total}) was on a very low level in all percolation steps in both soils. The first percolation step after three days of the Cambisol incubation showed the highest remobilization of Ag which was below 0.1% of the Ag_{total} concentrations in the soil columns. The correlation between remobilized Ag_{total} and Ag_{totalt} concentrations suggests that the remobilized amount of Ag was associated to soil colloids. The breakthrough of Ag ENP in the column percolation experiments was high but incomplete in the Cambisol and the Luvisol.

Particularly, columns with preferential flow pathways showed low Ag ENP remobilization. In the unsaturated experiments, a nearly complete retention was found for the Luvisol that showed a clearly smaller pore size structure than the Cambisol. The horizontal distribution of Ag_{totalt} in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Ag_{totalt} release to the percolate water (= 480 d, control= 24 ng l^{-1}, Lysimeter (7 mg kg^{-1}) = 56 ng l^{-1}, DIN 38422-11) was obtained for the lysimeter with the highest Ag ENP application. TNP was removed in the acidic pH range of the filtered percolate water (pH < 4) as well as in the pH range 7-8 and detected in the lysimeter with the lower Ag ENP concentration.All roots (wheat, canola, barley) showed a low uptake of Ag_{total}. All approaches showed a more or less high retention of Ag ENP in soils why soils are a sink for Ag ENP. However, the demobilization in the lysimeter was incomplete because of root uptake and inhibition of the soil microflora. Thus, the impact of a repeated sludge application to the soil microcosm and the root uptake (e.g. beet) needs further long-term investigations.

97 Determination of attachment efficiency (α) for ENPs in different types of soils by saturated column columns

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The attachment efficiency (α) has been suggested as the most appropriate fate descriptor for transport of engineered nanoparticles (ENPs) in soils and saturated column experiments as the most accurate method to obtain α. Due to the complexity of the soil composition and texture, a small change in composition of the column protocol may affect the resulting attachment efficiency obtained from the results. The aim of this work is to study the effect of soil composition, flow velocity, initial ENP concentration and the size of ENPs on the calculated attachment efficiency for the specific ENP-soil systems. The α values for nominally 20 and 80 nm citrate coated gold ENPs (Au ENPs), as well as 30 nm sulphonated silver ENPs (Ag, S ENPs) were determined in a series of columns with different soils sampled in the UK. Artificial rainwater was used as the eluent. 10 mM NaNO3 was used as a conservative tracer to estimate the effective porosity and dispersivity. All columns were packed with an excess of rainwater to limit the amount of air present in the saturated soil. α was either calculated from breakthrough curves of Au/Ag or from the irreversible attachment rate modelled using Hydrus 1D or the recent model of recovery of the ENPs in the break through curves. Preliminary results show no significant differences in α values for 80 nm and 20 nm Au ENPs. However, the Au ENP breakthrough curves appeared dependent on the flow rate. Even though the shape of the break through curves changes with flow rate, this can be compensated during modeling arriving at consistent α values between the systems with varying flow rates. Furthermore, presence of air in the columns affects the distribution of ENPs in the packed columns. Finally, an increase in initial ENP concentration give higher α values and cannot be accounted for in the equations used for estimating the attachment efficiency. In conclusion, when varying the initial ENPs concentration into the columns, the α value is significantly affected. Hence, low α concentrations need to be used in the column experiments to model the approachability of calculated α values. Moreover, inclusion of air in the systems appears to induce artefacts that complicate determination of α for specific NP-soil combinations.

98 The transformation of copper and zinc (-nanoparticles) during sewage sludge composting

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Engineered nanoparticles in wastewater streams are effectively retained by wastewater treatment plants and accumulate in sewage sludge. Digested sludge is subsequently combusted for further volume reduction to allow for phosporous recovery at a later stage. This study focuses on two metals Cu and Zn, as both are present in digested sludge but are also used as nanomaterials. We investigated (i) the transformation of ZnO and CuO-NP during anaerobic digestion, (ii) the subsequent transformation of Cu and Zn during sewage sludge combustion, and (iii) whether the form of Cu and Zn affects the fate during anaerobic digestion and combustion. We spiked CuO-NP, ZnO-NP, Cu+ and Zn+2 to four aliquots of digested sewage sludge. The four aliquots were kept under anaerobic conditions for 24h. One aliquot was kept as control. Thereafter, sludge was combusted in a pilot fluidized bed reactor and ashes were collected. Sludge and ashes were prepared for Cu - and Zn K-edge X-ray absorption spectroscopy (XAS) measurements. The speciation of the metals was obtained through linear combination fitting (LCF) of X-ray absorption near edges spectra (XANES) and extended X-ray absorption fine structure (EXAFS) data. LCF fits of experimental XANES and EXAFS data suggest a high degree of sulfidation of both Cu and Zn during anaerobic digestion, irrespective of the spiked form of Cu and Zn. For control sludge and sludge spiked with Zn++, LCF results from EXAFS data suggest that ~90% of the Zn was present as sulphides, the remaining fraction was best described by a ZnO reference spectrum. For sludge spiked with ZnO-NP, a lower degree of sulfidation (~83% ZnS) with a concomitantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a Znt-spectrum that was co-precipitated with Ferrihydrite. All LCF fits of Cu in the digested sludge indicated complete sulfidation of Cu. After combustion, LCF fits of the experimental EXAFS spectra revealed the presence of ~30% Chalcopyrite, indicating that Cu was not completely oxidised during the combustion. Comparable fraction of Cu(+3 and CuO) was returned from LCF analyses. All Cu spectra of the sludge and the ashes were very comparable and independent of the added form of Cu. For Zn, however, the addition of ZnO-NP resulted in a slightly lower degree of sulfidation compared to the control sludge and to the sludge that was spiked with dissolved Zn++. All Zn spectra of the ashes were comparable.

99 Soil ecotoxicity and dissolution of a marketed nanosilver product - a direct comparison with ionic silver

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As part of the REACH Substance Evaluation for silver, new data was generated to further justify read-across from ionic silver to silver nanoforms. Therefore, the soil ecotoxicity and dissolution of ionic silver vs nanosilver were tested. The smallest silver nanoform with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~83% ZnS) with a concomitantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a Znt-spectrum that was co-precipitated with Ferrihydrite. All LCF fits of Cu in the digested sludge indicated complete sulfidation of Cu. After combustion, LCF fits of the experimental EXAFS spectra revealed the presence of ~30% Chalcopyrite, indicating that Cu was not completely oxidised during the combustion. Comparable fraction of Cu(+3 and CuO) was returned from LCF analyses. All Cu spectra of the sludge and the ashes were very comparable and independent of the added form of Cu. For Zn, however, the addition of ZnO-NP resulted in a slightly lower degree of sulfidation compared to the control sludge and to the sludge that was spiked with dissolved Zn++. All Zn spectra of the ashes were comparable.

100 Tackling nanoparticle fate assessment in surface waters - heteroaggregation as a key process

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The increasing use of engineered nanoparticles (ENPs) inevitably entails emissions to the environment, raising calls for nano-specific environmental risk assessment approaches and regulations. As surface waters are the major receiving compartment, assessing risks requires understanding the aquatic fate of ENPs where they are usually soluble, in particular by coagulation, including homo- and heteroaggregation with natural suspended particulate matter (SPM), or stabilisation by natural organic matter (NOM). Due to the omnipresence and larger size of SPM, heteroaggregation is much more likely than homoaeggregation. However, integration of this process into fate models and exposure assessment requires parameterisation and is still limited by the lack of simple, yet environmentally relevant experimental protocols. Such could be developed along the lines of the recently adopted OECD testing guideline 318 on ENP dispersion stability, currently accounting only for homoaeggregation. The principles of homo- and heteroaggregation are basically the same: the probability of particle attachment is
controlled by the intrinsic particle properties and modified by the hydrochemical conditions (pH, electrolytes, NOM). Distinct from homoeaggregation is the complexity added to the system by SPM in the case of heteroeaggregation. In this contribution we therefore propose an approach to develop a heteroeaggregation testing protocol based on the OECD TG 318, with a focus on tackling SPM analogues selection. The development of such a protocol requires (1) selecting SPM analogues and homoeaggregation conditions simple enough to represent relevant environmental characteristics, and simple enough for routine testing, (2) an easy-to-handle experimental setup to estimate a heteroeaggregation parameter, and (3) an accurate experimental method to validate the latter. Point (1) requires informed simplifications based on a profound understanding of the system.

Relevant hydrochemical testing conditions have been established for homoeaggregation in the OECD TG 318 and will also apply for heteroeaggregation. However, suitable analogues for natural SPM still need to be selected. We therefore reviewed literature for typical compositions of riverine SPM and carried out screening tests aiming at the creation of complex analogues representing relevant characteristics. Comparisons with simple SPM analogues revealed distinct aggregation behaviour, indicating the importance of complex SPM analogues for heteroeaggregation.

**Advances in environmental risk assessment of oil spills and offshore oil & gas operations (II)**

**101**

MC-252 biomarkers as indicators of oil exposure and pollutant concentration in sediments of the northern Gulf of Mexico

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Different types of crude oil can be identified by the arrangement of constituents, or their chemical fingerprint. In addition, chemical fingerprinting can be used to identify contaminated sediments with specific spill events like the Deepwater Horizon disaster of 2010. Mississippi Canyon-252 (MC-252) source oil, the type of crude oil specific to the Deepwater Horizon event, has been fully characterized by researchers at LSU, including pattern identification of the ion 217 and 218 honepane/stereane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shauling regions of the Mississippi River delta were sampled to measure sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and MC-252 biomarkers. Pattern A, pattern B or NO pattern was assigned to each sample based on a visual assessment of the chromatographic profiles. Additionally, a main effects-model was implemented in order to determine the impact of environmental variables, including the presence and pattern of MC-252 biomarkers, on the sediment concentrations of ten PAHs and three toxicity indicators. Ninety-three percent of all sampled sediments (N=1,032) did not contain MC-252 biomarkers. Of the sediment samples containing detectable crude oil biomarkers, 5 percent displayed pattern A and 2 percent, pattern B. Most of the samples containing the families of biomarkers were located at the southern end of the Barataria Bay transect, a region that experienced moderate to heavy oiling during the Deepwater Horizon oil spill event. Additionally, MC-252 biomarkers did not account for any of the variability in the concentrations of the measured pollutants across the transects. A main effects-model was used in the current study. The lack of MC-252 biomarkers in the vast majority of the sampled sediments, indicated that the PAH contamination in the current study was not from the Deepwater Horizon oil spill event. There is need for better markers of the origin of PAHs in freshwater and marine sediments. Furthermore, crude oil is not the only or even the best indicator of potential toxicity of these sediments.

**102**

Downregulation of hsp90 and increased intermoul duration in the blue crab, Callinectes sapidus, in response to oil exposure

**S. Chiasson**, Loyola University / EEB; S.M. Giltz, C.M. Taylor, Tulane University / Ecology & Evolutionary Biology.

The 2010 Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (NGOM) resulted in over 780 million liters of crude oil spilling into Gulf waters. In an effort to disperse the oil, nearly 7.6 million liters of dispersant was applied. Many commercially and recreationally important species reside in or near the area of the spill. The blue crab, Callinectes sapidus, is common in the NGOM and is both economically and ecologically important in this region. In this study, after exposing juvenile blue crabs to DWH oil (pre-mixed with dispersant) we tested for a relative expression of heat shock protein 90 (hsp90) by measuring the corresponding mRNA expression. Expression of hsp90 is normally upregulated in response to thermal or environmental stress, and it also plays an important role in the regulation of estrogen dependent cell signaling. We also monitored crabs over two molts to test for effects on growth after exposing crabs to oil. Expression of hsp90 was significantly downregulated and dispersed crude oil had no effect on hsp90 expression in crabs exposed to oil alone was slightly elevated, although not significantly. However, the intermoul duration of crabs exposed to oil increased, meaning that exposure to oil results in delayed moulting and therefore slower growth.

**103**

Physiological and molecular impacts of crude oil and/or dispersant-contaminated seawater and sediments on the sponge Halichondria panicea (phylum Porifera).

**J. Vad**, Heriot-Watt University / School of Energy, Geosciences, Infrastructure and Society; J.M. Roberts, The University of Edinburgh / Grant Institute; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society

Sponges (phylum Porifera) are a diverse group of filter-feeder organisms present in most aquatic environments. In the marine environment, sponges perform a wide range of ecological functions including cycling of nutrients such as carbon, nitrogen and silica; and, in areas where they are present at high densities (spoon grounds), they provide a habitat for a diverse range of benthic organisms. Because of their importance within marine ecosystems, the impacts of anthropogenic activities such as hydrocarbon exploration and production on marine sponges must be assessed.

The objectives of this study were to: (1) determine the physiological impact of crude oil and/or dispersant contaminated seawater and sediments in model sponge Halichondria panicea; and (2) characterise the effects of crude oil and/or dispersant contaminated seawater exposure on the transcriptome of H. panicea. A series of 48-hydrocarbon compositions (MC-252) biomarkers did not recover for 48h after the end of the exposure to contaminated seawater. The transcriptome has been sequenced and analysis is underway to detect changes in gene expression patterns associated with treatments. Overall, results indicate that sponges respond to short-term exposure to crude oil and/or dispersants by cessation of their filtration behaviour. These initial results and our ongoing investigations will contribute to better understand the sensitivity of marine sponges to oil production activities.

**104**

Advances in the effects of UV on oil toxicity in aquatic organisms

**A.P. Roberts, K. Bridge**, University of North Texas / Advanced Environmental Research Institute; J. Morris, Abt Associates; B.J. Venables, University of North Texas / Advanced Environmental Research Institute; M.O. Krasnec, Abt Associates; M.L. Gielazny, NOAA / co USEPA Region IV

UV-photodynamic PAHs to biota, leading to adverse outcomes well below the threshold of photodynamic PAHs to biota, leading to adverse outcomes well below the threshold of other mechanisms of toxicity. This phenomenon is known as photo-induced toxicity and is well documented in a wide range of aquatic organisms. Consequently, laboratory tests investigating effects of PAH on aquatic biota which fail to account for phototoxicity by UV may significantly underestimate toxicity. The intensity of UV exposure to biota is highly variable within aquatic ecosystems, due to a number of factors intrinsic to the water column, and extrinsic factors (e.g. cloud cover, time of day, seasonal variations). Tissue repair mechanisms may be sufficient to counteract some effects of photo-induced toxicity during periods of relief from UV exposure. Here, we report the results of experiments in which larval red drum (Sciaenops ocellatus) and zooplankton (Daphnia magna) were exposed to either a single PAH (fluoranthene) or a complex PAH mixture prepared from weathered crude oil with varying PAH and UV exposure scenarios. Red drum tests were conducted as a single pulse exposure, and daphnia tests were conducted as static renewals. Toxicity (LC50) was UV and PAH dependent in both species. In red drum tests, shorter PAH pre-exposure times resulted in LC50 that were considerably lower than LC50 associated with longer pre-exposure periods. This is likely due to lag time in the initiation of physiological metabolism/clearance mechanisms in the organism and loss of PAH from the test chamber. A similar pattern was observed in photoperiod testing for both species. Significant latency mortality was observed in daphnia in several days after the conclusion of the UV and PAH exposures. We also report the effects of various UV-modified photoproducts on marine fishes. Taken together, these data suggest that even short-term, transient exposure to low concentrations of PAHs (common during a spill event) results in acute toxicity in aquatic organisms, and those effects may be manifested outside of standard bioassay testing durations.

**105**

Photoenhanced Toxicity of Petroleum to Aquatic Invertebrates and Fish: Review of the Science

**S. Chiasson**, Loyola University / EEB; S.M. Giltz, C.M. Taylor, Tulane University / Ecology & Evolutionary Biology.

The 2010 Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (NGOM) resulted in over 780 million liters of crude oil spilling into Gulf waters. In an effort to disperse the oil, nearly 7.6 million liters of dispersant was applied. Many commercially and recreationally important species reside in or near the area of the spill. The blue crab, Callinectes sapidus, is common in the NGOM and is both economically and ecologically important in this region. In this study, after exposing juvenile blue crabs to DWH oil (pre-mixed with dispersant) we tested for a relative expression of heat shock protein 90 (hsp90) by measuring the corresponding mRNA expression. Expression of hsp90 is normally upregulated in response to thermal or environmental stress, and it also plays an important role in the regulation of estrogen dependent cell signaling. We also monitored crabs over two molts to test for effects on growth after exposing crabs to oil. Expression of hsp90 was significantly downregulated and dispersed crude oil had no effect on hsp90 expression in crabs exposed to oil alone was slightly elevated, although not significantly. However, the intermoul duration of crabs exposed to oil increased, meaning that exposure to oil results in delayed moulting and therefore slower growth.
Photoenhanced toxicity is a distinct mechanism of petroleum toxicity that is mediated by the interaction of solar radiation with specific polycyclic aromatic compounds (PACs) in oil. Phototoxicity is observed as a 2 to greater than 1000-fold increase in chemical toxicity to aquatic organisms that have also been exposed to light sources containing sufficient quantity and quality of ultraviolet radiation (UV). Although the light intensity is not the only factor in photoenhanced toxicity, and weathered middle distillates, crude and heavy oils can exhibit photoenhanced toxicity, these same products do not exhibit phototoxicity in standard test protocols because of low UV irradiance in laboratory lighting. Fresh water, estuarine and marine waters have been shown to have sufficient solar radiation exposure to elicit photoenhanced toxicity, and a diversity of aquatic invertebrate and fish species can exhibit photoenhanced toxicity when exposed to combinations of oil and UV. Risks of photoenhanced toxicity will be greatest to early life stages of aquatic organisms that are translucent to UV and that inhabit the photic zone of the water column and intertidal areas exposed to oil.

Pilot microcosm study to assess the fate and toxicity of diluted bitumen in an outdoor aquatic environment.

J.M. Blais, University of Ottawa / Biology; M.L. Hanson, University of Manitoba / Environment and Geography; D. Orhel, Queens University; B. Hollebone, Environment Canada / Emergencies Science & Technology; V. Palace, M. Paterson, ISBD-Experimental Lakes Area; J. Rodriguez Gil, University of Ottawa / Department of Biology. Pipelines are the safest mode of transporting Canada’s oil to markets, but they are a concern for the public, especially the potential effects of diluted bitumen (dilbit) spills on the environment. We added diluted bitumen (dilbit) to two land-based microcosms (2 m diameter) containing water and sediment from a nearby lake at the ISBD-Experimental Lakes Area in Northwestern Ontario for a span of 11 days, and compared our results to a control enclosure with no added dilbit. Microcosms were treated with 0 (Control), 0.15, or 1.5 liters of Cold Lake Winter Blend dilbit (CLB-W), representing dilutions of 1:10,000 and 1:1000 (oil/water, v/v), which spans the range of historical dilbit spills to water. Samples of water, sediment, air and oil were collected through the study in order to determine the fate, weathering, and behaviour of the dilbit. Total petroleum hydrocarbons in the high treatment microcosm gradually increased from under 100 mg/L in the first 24 hours to over 1200 mg/L by day 11, with no evidence of reaching equilibrium over this duration. Although a decrease in total phytoplankton biomass was observed in all microcosms over the study, the biomass in the high microcosm was about one-half or less than that in the control microcosm for the first week. Thereafter, the rate of biomass loss in the dilbit-treated microcosms slowed down, which could indicate recovery of the primary producers as the oil slick sank to the sediments. This study is among the first to examine the behaviour of dilbit in an outdoor setting under natural conditions of sunlight, wind, and rain, and provides a case study that will inform future dilbit studies in natural (outdoor) environmental settings.

Fish model species in human and environmental toxicology (II)

Life-stage, and species-specific effects of dietary methylmercury exposure K. Hagberg, University of North Texas / Advanced Environmental Research Institute; Y. Zhang, University of North Texas Health Science Center; T. Curran, J.T. Magnuson, University of North Texas / Biology; M. Allen, University of North Texas Health Science Center; B.J. Venables, A.P. Roberts, University of North Texas / Advanced Environmental Research Institute. Mercury is a globally distributed contaminant, found even in remote aquatic ecosystems. Once deposition occurs, it can be microbially transformed into organic forms, such as methylmercury (MeHg) [1]. MeHg is highly bioavailable, and it bioaccumulates and biomagnifies in biota leading to potentially toxic body burdens in long-lived organisms at high trophic levels. MeHg can be actively transferred from mother to offspring, through large mammal air transporters with the potential to cause severe, irreversible effects on developing organisms. Here, we describe the developmental effects of exposure to methylmercury in a model fish species (Pimephales promelas). Exposure to environmentally relevant concentrations of MeHg during development led to alterations in the dopaminergic system, metabolism, gene expression, behavior, hatch time, size, and embryo-larval survival. Similarly, effects on the dopaminergic system in specific regions of the adult P. promelas brain were observed after a 30-day dietary exposure. Recently, a functional link between gut microbiota and dopamine production in teleosts has been established. The bidirectional communication between the gut and the central nervous system (CNS) is referred to as the gut-brain axis, which plays an important role in behavior, brain function, neurodevelopment, and the progression of neurodegenerative disorders. Therefore, we characterized MeHg-mediated changes to the gut microbiome composition in P. promelas adults. Because the dopaminergic system is highly conserved among taxa, we sought to confirm the altered dopamine concentrations in P. promelas brains a higher vertebrate species. Metabolomics was performed on the mid-brains of male mice (Mus musculus CD-1) exposed to similar concentrations of dietary MeHg for 30-days. Changes in dopamine concentrations of the telost brain were mirrored in the mid-brains of male mice, and several other significant changes to the mouse mid-brain metabolome were detected. Collectively, these results suggest current environmental exposure scenarios to MeHg are sufficient to induce a number of molecular-level changes that are associated with costs to whole organism fitness, with consequences for multiple life stages, and species. Due to the similar changes detected in mice, there is increasing evidence to suggest teleosts as a surrogate model species for studies assessing effects of MeHg on highly conserved systems in higher vertebrates.

Characterization of molecular toxicity pathways of Fluoxetine in rainbow trout and white sturgeon using RNA-Seq whole transcriptome analyses A. Alcaraz, University of Saskatchewan - Toxicology Centre / Toxicology Centre; B.K. Eisner, University of Saskatchewan / Toxicology Centre; S. Tang, Chinese Center for Disease Control and Prevention; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre. The increasing number of emerging chemical contaminants (ECCs) and their unknown effects to aquatic ecosystems serves as an impetus to develop advanced environmental risk assessment (ERA) approaches to improve regulatory decision-making. This is because current ERA rely on live animal testing that are expensive, time consuming and of ethical concern. Furthermore, the use of model organisms does not assure protection towards native species because of the limited understanding of their relative sensitivities and vulnerability. Hence, there is a need to establish an unbiased approach to characterize toxicity pathways that allow probing of an entire biological system without a priori knowledge of the mechanisms of toxicity. Advances in ‘omics technologies can improve current testing strategies as they offer high-throughput and cost-effective approaches to examine patterns of mechanistic toxicity which could guide endpoint selection and toxicological interpretation. A rapid increase in toxicology pathways models to predict outcomes of regulatory relevance for the selective serotonin reuptake inhibitor, fluoxetine (FLX), in 2 fish species of concern in Canada. Juvenile rainbow trout (RBT) and white sturgeon (WS) were exposed to 125 µg/L FLX in 96h static-renewal system, and sequence-by-synthesis whole transcriptome analysis was used to determine unique differential gene expression in fish livers and brains. A 0.05 cut-off false discovery rate identified differentially expressed contigs between FLX and control groups. A total of 406 and 429 contigs were significantly altered in RBT livers and brains, respectively. Of these, 238(59%) and 236(55%) matched unique gene names. In WS, 252 and 192 contigs were significantly altered in livers and brains, respectively, with 145(58%) matched unique gene names. The pathway analysis using ontologies based on zebrash in KEGG and GO Consortium showed a total of 101 affected pathways. Over half(58%) of the affected pathways were involved in biological processes while others were involved in cellular components (13%), molecular function (18%), and genetic information processing (11%). The results of this study will be compared to apical outcomes assessed in a parallel chronic study, and which will allow the assembly of toxicity pathways across multiple levels of organization with the end goal of identifying molecular markers that are indicative of adverse effects.

Transgenerational effects of early life stage exposure to endocrine disruptors across biological scales in a euryhaline model fish S.M. Brander, Oregon State University / Environmental and Molecular Toxicology; B. DeCourten, J. Forbes, University of North Carolina Wilmington / Biology and Marine Biology; N.P. Burns, University of North Carolina Wilmington / Department of Biology and Marine Biology; H. Roark, Hunter Roark / Biology and Marine Biology; J.W. White, Oregon State University / Department of Fisheries and Wildlife; A.C. Mehinto, Southern California Coastal Water Research Project / Toxicology; M.L. Settles, University of California Davis / Genome Center; R.E. Connon, University of California, Davis / School of Veterinary Medicine. Emerging research demonstrates that EDCs, which agonize, antagonize, and/or synergize the effects of endogenous hormones, can cause deleterious effects in higher vertebrates. Emerging research demonstrates that EDCs, which agonize, antagonize, and/or synergize the effects of endogenous hormones, can cause deleterious effects in higher vertebrates. As such, we examined the potential for transgenerational effects across three generations, with EDC exposure isolated to the parental generation (to 21 dph) only, across biological scales. This study is examining changes in gene expression, DNA methylation, histological analysis of reproductive organs, as well as altered fecundity, sex ratio, morphology, and immune response in the F0, F1, and F2. We are also sequencing the M. beryllina genome. F0 results show that early-life exposure to EE2 significantly skewed adult sex ratios (feminized) relative to controls. Findings from the F0 and...
F1 generations demonstrate that exposure to EDCs increased growth in the parental larvae, and that androgenic treatment groups (Levo, TB) maintain this growth through the subsequent F1 generation. In the F0 adults, differences in immune response are apparent between bifenthrin and levonorgestrel, and this pattern is stronger in F1 adults, with significantly greater T-cell proliferation in bifenthrin-exposed individuals relative to controls. Bifenthrin-exposed parental females have increased atretic follicles, and developmental defects are more pronounced in F1 embryos and larvae relative to parents. Future data gathered on gonadal histology, gene expression and DNA methylation will allow us to further hone in on the mechanisms causing higher order downstream effects. Elucidation of the mechanisms contributing to these higher order downstream effects will inform adverse outcome pathways, as well as allow for the quantification and comparison of responses to established and emerging endocrine disruptors across multiple biological scales.

110 Integrated OMICS and imaging for a better understanding of ecotoxicological mechanisms - PAH developmental toxicity as an example

E. Vehmaäinen, M. Quiroz, J. Jara, M. Rethinking Atmospheric Mercury Chemistry

The BioBio River (Central Chile) is the third most important basin in Chile and is considered a Biodiversity Hot Spot with 17 native species. It presents a high degree of intervention and fragmentation of this basin. The high degree of intervention and fragmentation of this river impacts the physiological/reproductive state of the native species Percilia irwini with this river impacts the physiological/reproductive state of the native species. It presents a high degree of intervention and fragmentation of this river impacts the physiological/reproductive state of the native species. It presents a high degree of intervention and fragmentation of this river impacts the physiological/reproductive state of the native species. It presents a high degree of intervention and fragmentation of this river impacts the physiological/reproductive state of the native species.

111 Physiological / Reproductive Status of Native Fish Exposed to a Complex Chemical Mixture in the BioBio River, Central Chile

M. Quiroz-Jara, Universidad de concepcion / Biomarcadores; S. Casini, Universidad de Siena / Scienze Fisiche della Terra e dell’Ambiente; M. Fossi, Universidad de Siena / Department of Physical Sciences, Earth and Environment; R.O. Barra, Universidad de concepcion / Aquatic systems; J. Gavilán, Universidad de concepcion / Celular Biology, Faculty of Biological Science

The BioBio River (Central Chile) is the third most important basin in Chile and is considered a Biodiversity Hot Spot with 17 native species. It presents a high degree of intervention and fragmentation of this river impacts the physiological/reproductive state of the native species Percilia irwini (n = 66) in situ. Different sublethal responses were evaluated through biomarkers at different levels of biological organization (Biochemical, cellular, and individual) and environmental parameters (pH, temperature, conductivity and total dissolved solids). The results obtained indicate an increase in the Hepatic EROD activity (ethoxyresorufin-O-deethylase) towards the lower third of the river. The Gonadosomatic Index (100 * (Total weight / (Total weight - Gonadal weight))) shows an increase towards the lower third, however, the gonadal histology indicates a protoplasmic growth and reduction of the diameter of the different stages of development of the oocytes determined for this species (n = 2332, p < 0.05). On the other hand, the collected specimens show a difference in weight and length, presenting specimens of less frequency of length in the lower third with respect to those present in areas with less intervention. These responses are associated with the increase of the values of environmental parameters towards this zone. The results of this study indicate a gradient of adverse biological effects by the convergence of point and diffuse contamination of complex chemical mixture and establishes the possible relationships between the physiological/reproductive alterations observed and the high degree of intervention of this river.

112 Sustainable Development Goals: the global context defining the agenda for government, business and academia

E. Giovannini, ASViS

Can the Agenda 2030 and the Sustainable Development Goals be the drivers to change the world?

M. Tamborra, European Commission - DG Research and Innovation

How the SDGs are being addressed in Horizon 2020

M. Recchiuti, European Commission - EASME

Why SDGs are relevant for a large enterprise

A. Valcaldia, ENEL

Conclusions

E. Tonda, UN Environment / Division of Technology, Industry and Economics (DTIE)

Questions and answers

Mercury Biogeosciences - Fate, Effects and Policy

M. Gustin, University of Nevada, Reno / Natural Resources and Environmental Science

Mercury (Hg) is considered a global pollutant. This is because it has a long atmospheric residence time. Because of the continued and increasing emissions of this pollutant to the atmosphere associated with anthropogenic activities, and the fact that once released from a geologic repository an atom of Hg may be potentially bioavailable for thousands of years, the Minamata Convention was developed and has come into force in November 2017. This global treaty focuses on protecting human health and the environment from the adverse effects of mercury. There are 3 general forms in the atmosphere- gaseous elemental Hg, gaseous oxidized Hg (HgO) and Hg(II) compounds), and that bound to particles. Gaseous elemental Hg can be transformed to gaseous oxidized Hg (GOM) by a variety of atmospheric oxidants. Once generated, GOM is readily deposited to ecosystems. Understanding the chemistry of GOM is important for predicting deposition velocities, availability in ecosystems, and potential for conversion to methylmercury. Methylmercury is a subtle neurotoxin and is bio-accumulated in ecosystems. Recent work using cation exchange membranes in the University of Nevada Reno –Reactive Mercury Active System (UNR-RMAS), and an air Hg calibrator system (Utah State University) have demonstrated that the standard measurement method for GOM –collection on a KCl denuder- results in underestimation of GOM concentrations by 2-10 times. In addition, thermal desorption profiles of GOM compounds collected using nylon membranes indicate that different chemical forms exist in the atmosphere. Data collected in urban areas, in the marine boundary layer, and at high elevation indicate that GOM compounds present are influenced by oxidants present in the air.
Different oxidized forms are produced in the free troposphere, marine boundary layer, and due to local oxidants in urban areas. Understanding atmospheric chemistry of GOM is important for developing instruments that will accurately measure GOM, and helping guide policymakers in developing solutions for reducing Hg emissions and contamination of ecosystems.

120 Evaluating spatial dynamics and species variation on mercury and selenium molar ratios in Northeast Atlantic marine fish communities

A.M. Azad, NIFES / Contaminants and biohazards; S. Frantzen, B.M. Nilsen, A. Dunker, National Institute of Nutrition and Seafood Research / Contaminants and biohazards; L. Madsen, National Institute of Nutrition and Seafood Research / Seafood in moderation M.S. Bank, Institute of Marine Research / Contaminants and biohazards; A. Maage, NIFES / Monitoring Programme

Seafood is the main dietary source of methylmercury (MeHg) exposure for humans and MeHg is a primary contaminant of concern for seafood consumption advisories. Co-occurrence of the Selenium (Se) and mercury (Hg) in seafood directly affect their bioavailability and toxicity. The protective and antagonistic effects of Se against Hg have been suggested to have antagonistic effects. We use samples collected from the Barents Sea, Norwegian Sea, North Sea, Skagerrak, North Atlantic and Norwegian fjords and coastal areas between 2006-2015. The data on the Se:Hg molar ratios in fish communities to assess species trends and spatial trends. In this study, the concentrations of total Hg and Se in 17 teleost fish species were measured using ICP-MS following microwave digestion(Julshamn, 2007 #72) and the Se:Hg molar ratios were calculated. Marine fish samples (n = 8525) were collected from the Barents Sea, Norwegian Sea, North Sea, Skagerrak, North Atlantic and Norwegian fjords and coastal areas between 2006-2015. The mean Se levels ranged from 0.27 to 0.78 mg kg⁻¹ wet weight (ww) in Atlantic cod (Gadus morhua) and Wolffish (Anarhichas spp.), respectively. The mean Hg levels ranged from 0.04 to 0.77 mg kg⁻¹ ww with the lowest level in Atlantic mackerel (Scomber scombrus) and the highest in blue ling (Molva diphrygea), leading to variation in the mean Se:Hg molar ratios from 1.9 in blue ling to 43.2 in Atlantic mackerel with Hg levels contributing most to the variation. In general, pelagic species had the lowest Hg levels and the highest Se:Hg ratios whereas deepwater demersal species had the highest Hg levels and the lowest Se:Hg ratios. Most species had a large portion (more than 50%) of specimens with a Se:Hg ratio exceeding 5 except for tusk (Brosme brossme) (4% less than 1, 53% between 1 and 5) and blue ling (19% less than 1, 80% between 1 and 5). Se and Hg levels showed weak positive correlation (R from 0.24 to 0.70) in 13 of 17 species. The Se:Hg ratio was negatively correlated to fish length and Hg levels. Mean Se:Hg molar ratios varied across offshore areas for all species and a gradual decreasing trend was found for all species from north to south due to increasing Hg concentrations. Due to the EU maximum level of Hg and a Se:Hg molar ratio above one, we emphasize that fish from NEAO are generally safe regarding Hg contamination. Less than 1% of the total analyzed specimens had Se:Hg molar ratio less than 1 and the surplus Se may ameliorate the toxic effect of Hg to some extent.

121 The interaction of mercury and selenium across environmental media

J.R. Gerson, Duke University; L. Naslund, Duke University / Biology; H. Hsu-Kim, Duke University / Department of Civil Environmental Engineering; E. Bernhardt, Duke University / Biology

Both mercury (Hg) and selenium (Se) can bioaccumulate within aquatic ecosystems and be toxic to organisms when found at high concentrations. Individually, high concentrations of each contaminant can reduce the health of biota, but the presence of both trace metals has been suggested to have antagonistic effects. Due to this relationship, many studies propose that increased environmental concentrations and consumption of Se is a pathway to reduce Hg toxicity in organisms. Yet, despite this important link, little is understood about the biogeochemical processes that promote this antagonistic relationship. In fact, only two published studies have simultaneously examined the interaction of Hg and Se in both terrestrial and aquatic ecosystems. In this study, we seek to better understand the uptake of Hg and Se into biota, as well as the biogeochemical conditions that promote this pathway and evidence for antagonistic effects. We use samples collected from the mountaintop mined region of West Virginia, USA, where high concentrations of contaminants have previously been found in these watersheds. To answer this research question, we analyze total Hg (THg), MeHg, total Se (TSe), and Se speciation in water, sediment, biofilm, stream macroinvertebrates, and spider samples. Our results show that Hg, MeHg, and Se are bioaccumulating in the food chain, with the highest concentrations found in macroinvertebrates. We also find that this region is an anthropogenic point of concern for communities containing elevated concentrations of these two contaminants. Our data provide evidence of a wedge-shaped cluster for the relationship between Se and percent MeHg in bulk sediment and biofilm, suggesting that at high concentrations, percent MeHg in bulk sediment and biofilm are reduced. In craneflies and spiders, we find a negative correlation between Se concentration and both absolute MeHg concentrations and percent MeHg. These results suggest that Se inhibition of MeHg accumulation might occur both at the microalgal and macroinvertebrate levels.

Constraining Uncertainties in the Global Mass Balance of Mercury Using Observations and a Bayesian approach

S. Mustala, IIT Hyderabad; A. Qureshi, IIT Hyderabad / Civil Engineering

Uncertainties in global mercury mass balance are constrained in this work using all the currently available observations of mercury species in the global environment, and a previously published multimedia model for mercury, UncMet3. Reduced efforts help in estimating mercury concentrations and mass balances with greater confidence. Ten key input parameters that were identified to be significantly contributing to the output uncertainties in previous studies. These included: emissions of mercury to the atmosphere, reduction and oxidation of mercury in surface and sub-surface oceans, and partition coefficients of mercury species groups (Hg(0), Hg(II), Hg-p) in surface and sub-surface oceans. Then, a survey of literature on observations of mercury in the global environment is made. As these observations (for example, concentration of total mercury in air) are also key model outputs, we can update model inputs by comparing model simulated outputs to the actual observations. For this updating, a Markov chain Monte Carlo (MCMC) technique called Metropolis Hastings which is based on the Bayes rule is adopted. The observed concentrations of Hg(0) in atmosphere, dissolved gaseous mercury, and total mercury in surface ocean are collected from published literature and used to obtain a likelihood function. Input parameters and their confidence range are revised. A revised mass balance is obtained through a forward Monte Carlo analysis using updated inputs. It is found that the uncertainties in key input parameters (such as partitioning of reducible divergent mercury between suspended solids and water in surface oceans) have been constrained to a considerable extent, phenolacetic pharma (P% limitation) on relations between different mercury systems, uncertainties in key output results, such as evasion of mercury from ocean to atmosphere, are also reduced. From factor 650 to factor 50, and in net reduction of Hg(II) to Hg(0) in atmosphere from factor 36 to 10. Analysis of contribution to variances of inputs to output variances suggests that, still, parameters describing oceanic processes such as partitioning between suspended solids and water, and metabolism redox reactions in oceans, contribute more to variances in key model outputs, compared to parameters such as global mercury emissions. Therefore, more significant effort must be made in understanding mercury process in oceans rather than in conducting emission inventory exercises.

123 Effects of probable nutrient limitation on the relationship between mercury and marine microorganisms in seawater

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Microbial transformations of monomethylmercury (MMHg) and dissolved gaseous mercury (DGM) at the lower marine trophic levels are still not well understood. This is especially important in oligotrophic and nutrient-limited seas, where microbial food web and microbial loop dominate over classical (herbivorous) food web. Our research focused on the examination of the effects of probable phosphorus limitation (P% limitation) on relations between different mercury fractions (total methylated mercury – MeHg, and DGM) and autotrophic and heterotrophic microorganisms. We determined total mercury (THg), MeHg and DGM, alongside with relevant microbiological and chemical parameters in the Central Adriatic Sea. Using statistical analysis (non-metric multi-dimensional scaling, principal component analysis, Pearson's product-moment correlations), we assessed the microbial effects on Hg transformations and bioaccumulation. Only in the absence of P% limitation conditions (40 P%-limitation), we found that MeHg was significantly related to most chemical and microbial parameters, which is an indication of metabolism-dependent Hg transformations. The activity of heterotrophic low nucleic acid bacteria seems responsible for most of Hg methylation in seawater under P%-limitation. Under 40 P%-limitation conditions, DGM shows strong correlation with microbial fractions and chlorophyll a, which confirms previous research about biological DGM production. Contrary to MeHg, DGM transformations are probably not metabolically dependent, as most of these correlations can also be observed under P%-limitation. MMHg biomagnification from microeuston to mesozooplankton was observed through an increased biomagnification factor. However, the estuarine redox reactions in oceans contribute more to variances in key model outputs, compared to parameters such as global mercury emissions. Therefore, more significant effort must be made in understanding mercury process in oceans rather than in conducting emission inventory exercises.

124 Poster spotlight: M0333, M0334, M0335

Bioavailability and realistic risk assessment of organic
125 Anisotropic exchange kinetics of organic contaminants with passive samplers in sediment: is multiple-thickness passive sampling the better alternative?

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Passive sampling with thin polymer sheets is increasingly recognized as a superior technique due to its robustness and ability to measure non-polar organic chemicals in sediment porewater. For deducing true freely dissolved concentrations in the aqueous phase from measured polymer concentrations, the compounds are required to reach thermodynamic equilibrium between the polymer and the water phase. However, for in-situ deployment in stagnant sediment equilibration times are beyond practical time scales. The spiking of passive samplers with performance reference compounds (PRCs) has therefore been introduced as a way to deduce equilibrium concentrations from the release of PRCs over the deployment period. This approach relies on the assumption of isotropic exchange kinetics between the uptake of the native compounds into the polymer and the release of spiked PRCs from the polymer. Our aim was to test whether this assumption is valid in stagnant sediments in in-situ and ex-situ conditions, considering different types of sediment and PRC spiked concentrations. For the field study, we immersed low-density polyethylene (PE) and silicone thin sheet passives of multiple thicknesses and spiked with PRC for 5 months into contaminated sediment in the Oslo harbour. For the ex-situ study, Oslo harbour sediment and Horten harbour sediment was incubated with PRC-spiked PE under stagnant conditions at room temperature in the laboratory and samples were taken at various time points. From the PRC depletion field data, sediment porewater concentrations were modelled using the Fernandez-one-dimensional-diffusion model. In the additional field equilibrium concentrations were modelled using a multiple thickness one-dimensional diffusion model. The ex-situ uptake and release data were modelled with a one-dimensional diffusion model (uptake) and a simple exponential one-compartment model (release). The results showed that both in-situ and ex-situ data for uptake and release kinetics were not identical. In conclusion, the ex-situ experiment revealed that PRC release kinetics is also dependent on the initial PRC spiking concentration. In conclusion, the data question the usefulness of PRCs for passive sampling in sediment, as the use of polymers of multiple thicknesses can produce results that are free from biases caused by anisotropic exchange kinetics.

126 Sediment toxicity of chlorpyrifos: whole sediment bioassay vs. silicon disc passive dosing

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Realistic risk assessment of sediments polluted with organic contaminants is much more complex than tests with water samples. Physical and biological processes as well as contaminant bioavailability, may strongly influence the adverse effects on test organisms in whole sediment testing. The current work is the first of a series of studies to our group on whole sediment-obiligated silicon rubber (ESR) could allow for a major simplification of the assessment of the overall impact of organic contaminants in sediment. The aim of the current study was to demonstrate that ESR can transfer the chemical activity of the insecticide chlorpyrifos from spiked sediment to aquatic bioassays with ESR as a passive dosing material. The effect level of chlorpyrifos in a 28d whole sediment bioassay was compared to effect levels observed in a 4d ESR passive dosing test using first instar larvae of the midge Chironomus riparius. Additional sampling with polycarbonate solid phase microextraction (SPME) fibers in both sediment and ESR dosed water was used to align the bioavailable concentrations in both tests designs. The ESR samplers accumulated chlorpyrifos up to 12% of the total spiked chlorpyrifos amount within 1 month. SPME samplers in sediment had 1-3x lower concentrations than SPME equilibrated with ESR. Thus, the chemical activity in sediment as well as that released from the ESR in water were comparable within a factor of 3. The insecticide chlorpyrifos showed only slightly more toxic effect levels in a 28d whole sediment test than in the 4d ESR dosing assay. Bioavailable concentrations in SPME samples in both assays indicated lethally toxic freely dissolved concentrations in the range of 0.2-1.1 µg/L. This study suggests that the 4d ESR dosing assay with sensitive first instar midge larvae provides valuable and realistic insight in the toxic potency of insecticide contaminated sediment comparable to much more elaborate 28d whole sediment tests. Also, at lowest tested toxic insecticide levels, concentrations in SPME extracts were close to detection limits, so accurate measurements of safe bioavailable chlorpyrifos concentrations via SPME becomes problematic. This suggests that ESR dosing assays and chronic whole sediment studies could be used more effectively to demonstrate specific pollutant toxicity than chemical analysis of realistic sediment exposure levels.

127 Implementing desorption extraction methods into bioavailability-oriented bioremediation

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Regulators are starting to consider bioavailability within retrospective risk assessment frameworks for organic chemicals, however, implementation is not straightforward because the developments of bioavailability science have not always been translated into ready-to-use approaches for regulators. Possible pathways for translating bioavailability science into regulation of organic chemicals have recently been identified (Environ. Sci. Technol. 49:10255-10264, 2015). A simplified approach was proposed in which the assessments of soil/sediment and the chemicals should be based on two measurable values: the total extractable concentration and the bioavailable concentration as measured with robust and reproducible chemical and/or biological methods. One of the chemical methods which has been proposed to measure bioavailability of hydrophobic chemicals (HOCs) such as PAHs is the desorption extraction with Tenax during 2h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001). Integr Environ Assess Manag, 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retroactively contaminated land management but also prospective risk assessment applied in the approval and regulation of organic chemicals. With the aim of providing pathways for implementation into regulatory contexts, we carrying out desorption extraction measurements with Tenax in a greenhouse experiment in which different strategies (use of slow degradation polyethylene (PE) and silicone thin sheet passive dosing the better free from biases caused by anisotropic exchange kinetics.
contaminated soils collected from two gasworks sites in the UK. Site 1 had a total polycyclic aromatic hydrocarbons (PAHs) concentration of 3500 mg/kg, and total aliphatic concentration of 1500 mg/kg. Site 2 had a lower concentration of both aromatic and aliphatic hydrocarbons 250 mg/kg and 350 mg/kg respectively. Heavy metals (HMs) concentrations in both soils ranged between 600 and 1200 mg/kg and the main elements were Zn, Pb and Cu. Both soils were amended with either 5% biochar or 15% compost in order to achieve metal stabilization and enhance soil degradation. The toxicity and bioavailability characteristics of the HMs were determined after 0, 30, 90 and 180 days. Further to this microbial biomass, soil respiration, phospholipid analysis, Microtox toxicity, earthworm’s lethality and seeds germination were carried out to assess how ecological health changed as the soils underwent remediation treatments. The study showed that, for both soils, microcosms amended with compost showed the most significant reductions in toxicity. The microbial number and respiration activity increased by two orders of magnitude after compost addition. Conversely, there was no significant difference between non-treated and biochar amended soils. At the onset of the experiment, no seed germination was observed in Soil 1 (non-treated) whereas an increase in seed germination was observed after 90 days for mustard and rape grass, and after 30 days for peas. The compost treatments had the highest percentage germination for both soils across all seed types. Similarly, the earthworms assay showed there was significantly greater survival rate at the end of the experiment compared to the onset. The biochar treatment resulted in a lower survival counts compared with compost treatment, with the non-treated samples having the lowest results. Preliminary results suggest that addition of compost and biochar accelerated the degradation rate of hydrocarbons compound and contributed in reducing toxicity of the soils. The degradation of PAHs and re-distribution of HMs will be evaluated with a multivariate analysis; data will be explored to highlight associations between contaminant’s concentration (reduction) and its influence on biological properties and toxicological responses in mixed contaminated soils.

130 Impact of Biochar Additions to Soil on Contaminant Sorption and Plant Bioavailability

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Reclaimed water is increasingly used in arid and semi-arid regions for irrigation. Contaminants in the reclaimed water, (e.g. pharmaceuticals and personal care products (PPCPs) and metals) could accumulate in exposed crops. Biochar is a potentially cost-effective soil amendment and contaminant sorbent that could reduce the plant bioavailability of reclaimed water associated contaminants. But the biochar biodegradation and the sorption of pollutants in biochar has undergone pyrolysis (decomposition at high temperatures with no oxygen). The main objective of this study is to investigate the impact of wood biochar on the crop bioavailability of selected PPCPs found in reclaimed water. A secondary objective is to quantify the contaminant sorption-desorption characteristics in the amended soils and to determine if there is a relationship with plant bioavailability.

The main objective of this study is to investigate the impact of wood biochar on the crop bioavailability of selected PPCPs found in reclaimed water. A secondary objective is to quantify the contaminant sorption-desorption characteristics in the amended soils and to determine if there is a relationship with plant bioavailability. PPCPs were selected as target contaminants because of their widespread occurrence in reclaimed water and their potential impact on animals feeding on the irrigated crops. Target PPCPs were selected based on chemical properties, widespread use, frequent detection in WWTP effluent, and potential risk to the environment. The target PPCPs represent a range of therapeutic uses including antibiotics linked to antibiotic resistance in bacteria (sulfamethoxazole (SMZ) and trimethoprim (TR)), an anticonvulsant that prevents seizures and relieves nerve pain (carbamazepin (CBZ)), an antibiotic (sulfamethoxazole (SMZ)) and an antileukemic (fluoxetine (FLX)), and an antihypertensive (angiotensin II receptor antagonist (ATZ). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and rye grass, and after 30 days for peas. The compost treatments had the highest percentage germination for both soils across all seed types. Similarly, the earthworms assay showed there was significantly greater survival rate at the end of the experiment compared to the onset. The biochar treatment resulted in a lower survival counts compared with compost treatment, with the non-treated samples having the lowest results. Preliminary results suggest that addition of compost and biochar accelerated the degradation rate of hydrocarbons compound and contributed in reducing toxicity of the soils. The degradation of PAHs and re-distribution of HMs will be evaluated with a multivariate analysis; data will be explored to highlight associations between contaminant’s concentration (reduction) and its influence on biological properties and toxicological responses in mixed contaminated soils.

131 LCIA method developments in a global perspective: Status and outlook (II)

131 A novel framework for a new generation of water consumption indicators in LCA and footprint studies

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Available freshwater consumption indicators for use in LCA and water footprint studies implemented in LCA software are based on either a volumetric approach of the water consumed (what we called first generation of indicators) or on stress-indices (what we called second generation of indicators). The first generation only performs an inventory and thus a partial footprint assessment according to ISO 14046, while the second generation shows limitations in describing the consequences of a lack of water at the endpoint. To date, no LCA method comprehensively distinguishes water masses (e.g. surface water and ground water) and other water flows (e.g. transport flows of water to and from atmosphere) within the boundaries of a watershed (e.g. evaporation) and beyond (e.g. groundwater and air advection), thus overlooking details in hydrological processes that affect environmental relevance of the assessment. In addition, a structured LCIA framework is currently lacking, as can be observed by the scattered and often incompatible developments of water fate and impact assessment models published in recent years. These models are all valuable contributions in themselves, but impossible to combine to an integrated, global characterization model that makes such developments operational in LCA. The challenge of improving environmental relevance of current water consumption indicators has been tackled by the Water Use in LCA (WULCA) working group within the UN Environment Life Cycle Initiative by developing consensus-based guidelines for the third generation of water consumption indicators, with a focus on compound-specific water consumption as an essentia term of the AoP. Thus, we propose a new framework for the operationalisation of the guidelines has the potential to harmonize current and future methods under a unique framework and to enhance the environmental relevance of the water use impact category in LCA.

132 A midpoint indicator for freshwater resources

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Freshwater resource has been recognized as being a safeguard subject within the Aims of Protection (AoP) framework. The potential of the Water Use in LCA (WULCA) resource group framework has been discussed. As recommended in the WULCA freshwater resources framework the concept of recovery period is used: when the recovery period lasts longer than a given period of time, potential impacts to freshwater resources (i.e. affecting freshwater availability for future generations) need to be considered. Based on literature review, we set the time period at 100 years, which requires a dynamic fate model. The dynamic fate model that has been used was the dynamic version of the USEtox® model. This provides the time-integrated pollutant mass remaining in the freshwater compartment (at continental scale) after 100 years m³/100 (in kg/day). Then, the quantification of the effect factor is based on the concept of adsorption processes with activated carbon. This allows for an indicator based on physical properties of the pollutant which is (i) substance specific, (ii) dependent on the level of pollution (i.e. chemical mass in freshwater), and (iii) proportional (although not covering energy requirements) to the effort necessary to fully remediate the persistent pollution. Therefore, the substance-specific characterization factor has a unit of mass equivalent of activated carbon per kg emitted [kgac/kgem] and represents a midpoint. It does not describe the effects of a substance’s behaviour of future natural reactions when facing water pollution, but rather indicate the potential effect required to recover the pollutant from freshwater resources depending on the persistence of the pollution and its difficulty in being remedied. Thus, this approach provides a new perspective allowing more transparent results for the differentiation of safe, long-term water supply issues (AoP natural resources) and potential (short-term) toxicity effects (AoP human health).
quantity potential water consumption impacts on freshwater ecosystems. In existing mechanistic models, mostly based on species-discharge and species-area relationships, ecological requirements are not taken into account. This implies considering equal response to stress for different taxa, overlooking the relationships between species and their habitat, along with other aspects of biodiversity (e.g. abundance). In this study we want to show the importance of habitat modelling to describe the impact patterns of water consumption on ecosystem quality. We propose a new functional LCA model based on freshwater system habitat and discuss the applicability at the regional and global scale. Water consumption may alter stream discharge and other related physical variables. Habitat suitability equations can be used to quantify physical habitat availability for freshwater species in Weighted Usable Area (WUA). Starting from WUA equations, a Habitat Change Potential (HCP) model is developed for riverine species. Eventually, the global HCP model’s applicability has been discussed. HCP is highly correlated with river size. The aggregation at reach scale is driven by specific taxa and by positive HCP scores (habitat loss). The result of the aggregation at watershed is consistent with existing evaluations of hydromorphological pressures in Europe. The main challenge in applying HCP globally is due to hydrological and hydraulic data averaged by the modelled area. It is however possible to find convergences between European and extra-European species habitat preferences. The proposed model is a promising effect factor for mechanistic impact characterisation which should be integrated with fate factor models describing hydrological alteration at a compatible spatial resolution. Since habitat models are based on species abundance, HCP represents the first step towards developing biodiversity damage indicators complementary to species loss.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (III)

134 The use of dynamic stock model to the definition of characterisation factors for biotic resources depletion

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Biotic natural resources have received little attention by the LCA community and this tempers the use of LCA for fish based food and feed products. Current LCA methods do not assess the impacts of biotic compartment on biotic stocks very well. The dynamic of biotic stocks (i.e. population) is a well-studied topic in theoretical ecology and it is commonly used for fish stocks management. The main of the present work is the use of this knowledge to assess biotic resources depletion in LCA. This is illustrated by the definition of characterisation factors (CF) for fish stocks depletion. The relationship between inventory and impact is often determined by the marginal abatement. Where a CF is used for quantifying and marginal change in impact according to a marginal change in inventory. Here, the Depleted Stock Fraction (DSF) is considered to be the assessed impact while the elementary flow of the inventory is a mass of fish removed from the biomass stock. The marginal approach is applied to the Schaefer model, a commonly used model in fisheries representing the dynamics of the biotic stocks. It combines catches, current biomass and maximum intrinsic growth rates of the stock (population). To determine these parameters for most of the world fisheries, catch time series were used for species of FAO Global Fishery and Aquaculture Statistics. This allows assessing all fisheries of the world in the LCA framework with a midpoint biotic resource depletion impact. To our knowledge, this work is one of the first assessments of depletion in LCA, based on a model of population dynamics. We are confident this will bring improvements to the LCA of fish-based products, allowing for the comparison of different fishery alternatives with respect to the use of marine biotic resources. One of the extensions of this present work could be the definition of CFs for terrestrial biotic resources where similar dynamic stock models are used. This advocates the use of a similar approach based on population model dynamics for both terrestrial and marine biotic resources.

135 Accounting for soil quality effects of agricultural land management in LCA

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Soil quality is an inherent aspect of agricultural sustainability, life cycle impact assessment (LCIA) methods should account for the effect of agricultural land management on soil quality. Despite a lot of efforts that have already been made, there are still several research needs on the integration of soil quality effects in LCIA methods. Ideally, inventory data are translated into the effect on the environment by indicators moving along the cause-effect chain from mid- to endpoint towards an area of protection (AoP). Although soil quality changes are often related to the AoP ecosystem health, we focus on the AoP natural resources as we refer to the impact of land management on soil by the long-term ability to produce biomass. To improve the usefulness in the agricultural sector, different land use intensities should be distinguished. We therefore introduce three interdependent LCIA indicators. At early midpoint, SOC changes (SOC1, indicator 1) are used to indicate the long-term effect of agricultural land use on soil. This can result in biomass productivity losses (BPL, indicator 2). At endpoint, we propose additional land requirements (ALR, indicator 3) as indicator, which corresponds to the area needed to produce the yield that has been lost. To characterize factors (CFs), we chose as reference situation the highest achievable SOC stock and yield, which are calculated for each initial soil quality stock. The models RothC and EU-Rotate N are used to quantify SOC stocks and yields, respectively. CFs are developed for several rotation systems in Flanders. Though, the elaborated framework is generally applicable and allows the calculation of CFs for other regions. Thanks to the use of an achievable reference situation and a distinction between land management strategies (good, bad and standard practices), the indicators can be a useful tool to strive for a more sustainable agriculture.

136 Poster spotlight: MO093, MO094, MO106

137 Full-scale WWTP balancing with passive samplers offers new insights in xenobiotic elimination processes

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Calculating elimination rates for full scale wastewater treatment plants is very demanding because it requires the knowledge of mixing regimes to match inflow to out flow volumes which translates very often in sampling campaigns that span over several days. While a certain progress in understanding elimination processes of xenobiotics has been gained from laboratory reactor tests, reliable and large datasets from real-life full scale plants are still missing due to the cumbersome sampling effort. Here we implemented the use of passive samplers to establish a feasible pathway to find full-scale xenobiotic elimination processes. Population equivalent loads proved to be within expected ranges from the literature and non-outlet of treatment plants and hence be able to directly calculate elimination rates. The method was validated in a pre-study with parallel autosampling and then applied to 18 WWTPs representing a large range of design properties such as hydraulic and sludge retention times. Normalisation with carbamazepine and lidocaine proved to be robust since both inlet-outlet ratios were well correlated and elimination rates of the investigated compounds fell into the ranges documented in literature. Furthermore it was possible to identify patterns of elimination by applying a cluster analysis and several compound elimination rates were found to negatively correlate with sludge retention time and hence to be more related to active biomass of the sludge. Inlet loads of the compound could be calculated by calibrating the more invariant outlet concentrations to passive sampler masses and then back calculating to inlet loads via the elimination rates. Population equivalent loads proved to be within expected ranges from the literature and non-domestic sources could be identified. Passive sampling might hence close the gap of investigation in xenobiotic behaviour on full-scale treatment plants and serve as well as a routine performance surveillance tool.

138 Screening of wastewater-borne pharmaceuticals and their phototransformation products in rivers

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Pharmaceuticals are continuously discharged into the rivers from wastewater treatment plants. Hundreds of wastewater-borne xenobiotics have been detected in river samples but their concentrations along the river change constantly due to additional inputs and natural attenuation processes. Apart from biodegradation, drugs can undergo phototransformation reactions by either direct or indirect photolysis including reactions with singlet oxygen (1O2), hydroxyl radical (•OH), peroxo radicals (•OOH), photo-excited organic matter, and other reactive species. To evaluate these processes in a river, usually laboratory studies are
performed in a first stage and then in the next step studies are conducted directly in the natural environment. In our group, we proposed a workflow using the combination of HRMS and processing software for evaluating the phototransformation of pharmaceuticals on a single compound basis under simulated and real environmental conditions. In contrast to this compound-by-compound approach, in the new approach presented here, degradation was not assessed for a single compound but instead a cocktail of human drugs was subject to the transformation process. Following the identification of photo-TPs, a list of suspect TPs was created and used to screen them in SPE-concentrated river water samples. For the generation of photo-TPs, reconstructed surface water was spiked with a cocktail of 34 pharmaceuticals at concentrations of 10 μg/L and exposed to artificial light in a sunlight simulator. Using the HRMS-MS/MS-MS/SIMS-1 generation tandem mass spectrometry, surface water samples originating from rivers were screened for their presence. For the enrichment of the potential photo-TPs, water samples were preconcentrated on four SPE cartridges connected in series and then analyzed using the same system mentioned above. With this methodology more than 30 photo-TPs were detected in the irradiated reactor samples. As of the time of submission of this abstract, the identification and quantification of some of the photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

139 Degradation of a polymer probe exposed to different wastewater environments: Linking chemical transformations and potential microbial consumers


The objective of the present contribution was to link the chemical transformations observed in a polymer probe exposed to the different aquatic environments found in a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tank (H2R) and some of the photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

140 Optimization of Laccase Catalyzed Iodine Synthesis as Enzyme Based Disinfectant

g. yí ukse, Universite de Sherbrooke / Civil Engineering

In addition to traditional and new generation water pollutants, microbial contamination is still one of the major problems that has affected the potential recycle and reuse of wastewater for domestic or industrial usage. Selection appropriate treatment approach has played an important role not just to reach discharge limits, it is also important to decrease human footprints in the environment. Some hydrolytic and oxidative enzymes (i.e., Laccase) is capable of oxidizing reactive iodide to reactive iodine, when they can play roles to degrade recalcitrant pollutants in wastewater. The resulting iodine represents a powerful antimicrobial compound. The aim of this study is investigating the potential of acetophenone and phenolic organic contaminant acetonaphen as mediator in a laccase mediator system to generate disinfectant iodine. The stability of reaction can be changed depending on the pH, temperature and multiple compound existence and system optimization is required to stabilize iodine synthesis. In this study, two different free laccases and insolubilized as cross-linked enzyme aggregates have been tested. Acetone synthesis is investigated with different KI (0-400 M) concentrations and different T. Flavescens (5, 10, 30 and 40 Unit/L) for 5 hours. Compounds were injected in distilled water as well as in the influent and effluent samples of wastewater treatment plants to see synthesis of iodine while the micropollutants have been removed in Laccase Mediator System. In the experimental sets, removal of persistent compounds were determined by LC/MS-MS and LC/TOF-MS. In general, enzyme synthesis and disinfection effect of iodine measured by fcal coliform tests. 0.35 maximum mML iodine concentration could be synthesized during experiments. During iodine production, while phenolic compounds' concentrations were decreased (50% acetonaphen removal in real effluent wastewater treatment plant), removal of non-phenolic compounds such as naproxen were also observed (50%). The results have shown that the biocatalytic generation of I2 was possible using laccase-mediator system. Iodine production was affected by the initial laccase activity and mediator concentration. Laccase catalyzed bacterical activity in municipal wastewater was also assayed without the addition of any mediator assuming that wastewater already contains mediators such as acetonaphen. Using this system, non-fecal coliforms present in the tested wastewater were removed.

141 Halogenated methanesulfonic acids in drinking water - Identification, standard synthesis, and analysis

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Persistent, bioaccumulative, and toxic (PBT) substances have been monitored since the 1960s. PBT substances are usually not well water soluble and tend to adsorb to sludge, soil and other particular matter, and thus spread slowly in the environment. However, as a consequence of their high environmental stability, they can eventually reach even remote areas like the arctic, and pose a threat to apex predators due to their ability to accumulate in the food chain. Persistent, mobile, and toxic (PMT) environmental contaminants, however, do not accumulate in the food chain, but are much more mobile in aquatic environments, and thus, they spread faster throughout the environment. Among the PMTs, halogenated methanesulfonic acids (HMSAs) are of particular interest. As they are mobile chemicals, they can be found in the environment in different countries.

Building of large-scale inventories of emissions and resources and applications for environmental footprints of territories, nations and sectors

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The European Inventory of Existing Commercial chemical Substances (EINECS) lists over 100 000 chemical substances used on the market. Over 16 000 chemical substances have been registered in REACH since 2008. In comparison, only ca. 3 000 substances are considered in life cycle impact assessment (LCA) to express their potential toxic impact on human health (cancer and non-cancer effects) and freshwater ecosystems. Because of human activities, those pollutants may enter the environment in several different ways: they are emitted to air from the combustion of materials, released through wastewater from industries and households, applied to soils together with manure and pesticides, etc. Combined with the intrinsic variability of release data, the sheer number of substances and the large variety of emission sources are challenges that one needs to overcome to quantify the overall toxic impacts of a country. Here, we therefore propose an updated methodology to build national inventories of toxic emissions in EU Member States in 2000-2014. The framework builds on earlier works and differentiates environmental compartments (air, water and soil) as well as anthropogenic sources (industries, households, manure and pesticides application on agricultural soils). It relies on existing and publicly available data, and extrapolation techniques are developed and used to fill in the gaps across countries in the entire period 2000-2014. The resulting harmonized inventories cover more than 500 substances, including both organics and inorganics such as persistent organic pollutants and heavy metals. Albeit still limited in substance coverage, it is thus possible to analyze the contribution of each substance and anthropogenic source to the toxic impacts on human health (human toxicity) and freshwater ecosystems (freshwater ecotoxicity), using LCA methods such as the consensus model USEtox.

144 Combining economic modelling and LCA to assess regional policies: key learning points from a case study on the French forestry sector
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Economic modelling is increasingly used in Life Cycle Assessment (LCA) to perform consequential LCA for the environmental assessment of product and services. Economic models can also provide significant enhancements for assessing the effects of regional policies, such as in territorial LCA approaches. Among them, equilibrium models appear as a good compromise to assess both socio-economic and environmental impacts of regional policies in an exhaustive and representative way. However, there are still some bottlenecks when trying to combine both approaches in practice. For instance, the levels system aggregation and discrepancies within the two models - the economic and LCA-based models - are required to ensure a consistent combination while limiting the time spent to collect data. This talk aims at providing insights on the combination of a partial equilibrium model, the French Forest Sector Model (FFSM), and LCA to assess the eco-efficiency of two regional policies supporting local wood industries in the French East Region. Two approaches will be used to combine economic models with LCA: Life Cycle Inventories (LCI), i.e. i) Extended Environmental Input Output modelling and ii) a method based of MFA (Material Flow Analysis) and process-based LCA. Eco-efficiency ratios based on economic and environmental impacts allow identifying scenarios with best environmental performances. In addition, this combination allows considering supply and demand dynamics, and thus the socio-economic effects of a decision. Using two different approaches, we are able to compare strengths and weaknesses of both types of combinations and discuss them considering policy assessment results, system representation and system boundaries. Thus, our work provides both insights on down-to-ground policy analysis and methodological developments on combining economic modelling with LCA. Here, economic modelling outputs are used as LCA inputs but more integrated modelling could be performed for completeness and optimization purposes. Perspectives on a stronger coupling will also be discussed.

145 A regional life cycle approach for assessing the climate change mitigation potential of bioenergy: from cradle to grave
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Keywords: Regional, spatial, biobased economy, GHG While traditional life cycle assessment is a powerful tool, for spatial applications, it is limited. With the ever increasing drive towards regional biobased circular economies, as a means of ensuring future climate change mitigation, there is a need to produce more regional and spatially representative life cycle assessments of biobased systems and bioeconomy regions. “RELC”, a Regional Life cycle inventory approach, was developed to assess the regional and spatial variation in the environmental performance of bioenergy production within a focus region. Through the use of catchment delineation, conventional geographical modelling is combined with life cycle software to assess the potential environmental burdens of regional bioenergy configurations (i.e. bioenergy plants and their biomass catchments). RELCA was used to assess the climate mitigation potential of biodiesel, for the region of Central Germany. With this approach we showed, for the focus region, that the mitigation potential changed between the different biodiesel configurations, due to their location within the region. When compared to a fossil diesel competitor (83.8 CO₂eq./MJ) the climate change mitigation potential of the regional biodiesel ranged between 53%–62%. When the results were compared to the typical RED (Renewable Energy Directive) values, a 13-31% greater mitigation potential than the RED was observed. The latter, illustrating that regional variability cannot be captured with a simple regional average value or default value. Additionally, scenarios were used to test the mitigation potential of reduced nitrogen fertiliser application during the biodiesel production phase. The results of the scenarios indicated that while reduced nitrogen fertiliser led to emission reduction per hectare, the greater land area input required to meet the demand of the biodiesel plants, led to an increase in emissions ranging from 1.14-5.71 g CO₂eq./MJ biodiesel. Thus, highlighting that assessments of biobased systems should consider configurations of biomass and conversion plants in order to determine appropriate mitigation strategies. Therefore, the ability to account for the territorial geograpical characteristics found within a region, using life cycle approaches, is important to support more sustainable regional resource management.

146 LCA_WIND_DK: temporally, geographically and technologically-sensitive life cycle inventories for the Danish wind turbine fleet
The environmental performance of a wind turbine is usually calculated as the ratio of the life cycle impacts occurring during the operation phase. However, there are still some bottlenecks when trying to combine both approaches in practice. For instance, the levels system aggregation and discrepancies within the two models - the economic and LCA-based models - are required to ensure a consistent combination while limiting the time spent to collect data. This talk aims at providing insights on the combination of a partial equilibrium model, the French Forest Sector Model (FFSM), and LCA to assess the eco-efficiency of two regional policies supporting local wood industries in the French East Region. Two approaches will be used to combine economic models with LCA: Life Cycle Inventories (LCI), i.e. i) Extended Environmental Input Output modelling and ii) a method based of MFA (Material Flow Analysis) and process-based LCA. Eco-efficiency ratios based on economic and environmental impacts allow identifying scenarios with best environmental performances. In addition, this combination allows considering supply and demand dynamics, and thus the socio-economic effects of a decision. Using two different approaches, we are able to compare strengths and weaknesses of both types of combinations and discuss them considering policy assessment results, system representation and system boundaries. Thus, our work provides both insights on down-to-ground policy analysis and methodological developments on combining economic modelling with LCA. Here, economic modelling outputs are used as LCA inputs but more integrated modelling could be performed for completeness and optimization purposes. Perspectives on a stronger coupling will also be discussed.

147 Assessing environmental impacts of individual households: A large-scale bottom-up approach
A. Froemelt, ETH Zurich; R. Buffat, ETH Zurich / Institute of Cartography and Geoinformation; N. Heeren, S. Hellweg, ETH Zurich / Institute of Environmental Engineering
Besides governmental consumption, household consumption is the main driver of economy, and is thus ultimately responsible for the environmental impacts that occur over the whole life cycle of goods and services, from production to installation. Therefore, assessing environmental footprints of households is an important basis to identify environmental policies. This study aimed to develop a comprehensive regionalized bottom-up model for Switzerland that is able to assess the environmental impacts induced by individual households. The purpose of this model is to provide a virtual platform for detailed scenario analysis which shall support effective political decision making on different scales. Three existing bottom-up models were merged: a building stock energy model, an agent-based transport simulation and a household consumption model. All of them were tested and evaluated beforehand. The physically-based building energy model establishes
simplified energy balances for each residential building based on spatially and temporally resolved climate data, building characteristics and 3D-geometries. It provides estimates of space heating, hot water and electricity demand for each household. The mobility sub-model builds upon the results of an agent-based traffic simulation framework which was applied to Switzerland and reproduces mobility patterns of Swiss inhabitants in space and time. The third sub-model provides a data-driven approach and enables the quantification of consumption of food, consumables, and other goods and services for each Swiss household by means of data mining techniques. Linking these sub-models with environmental background data allowed for computing an environmental profile for each household in Switzerland. The application of this model to the current situation of Switzerland reveals interesting differences between individual households, district, region and different location areas. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all three sub-models permits testing of policies and in-depth analyses of scenarios, ranging from detailed building refurbishment programs to future mobility solutions such as autonomous vehicle systems.

**Mechanistic effect modeling for risk assessment: applications, use in a regulatory context and future directions**

**Modelling ecological scenarios for the assessment of chemical effects on stream communities**

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The ecological risk assessment of chemicals (ERA) aims at quantifying the likelihood of adverse ecological effects posed on populations and the communities they comprise. Effects caused by the exposure of organisms to chemicals can however to a great extend depend on environmental scenarios as well on the states, behaviours and interactions of organisms with consequences for individual life history, population responses and community dynamics. In this regard, our major objective is to suggest how to model stream ecological scenarios for ERA. We suggest to employ ecological classifications as defined within the Water Framework Directive. Here, the ecological scenario is a virtual representation of an ecosystem, which involves both abiotic components (habitat scenario) and biotic components (the functional and life history scenario). Technically, we integrate spatial explicit habitat information in form of raster maps, temporal information on abiotic factors like temperature and chemical exposure, functional trait data bases, dynamic energy budget models and process based effect models to simulate macroinvertebrate and fish assemblage dynamics. In model applications, we explore to what extent the ecological scenario will affect the adverse outcome of chemical exposure.

**Robust implementation of TKTD models with Bayesian inference**

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The application of toxicokinetic-toxidynamic (TKTD) modeling proved to be of particular interest in strengthening the Environmental Risk Assessment (ERA) of chemicals compounds (e.g., REACH dossier accounting for toxicity of industrial discharge, evaluation of impacts of Plant Protection Products (PPPs), ...). TKTD models describe the time-course of processes leading to toxicity at the level of organisms. These models include all mechanisms from the toxicokinetics part describing the compound fate from external concentration to internal kinetics (e.g., exposure, uptake, elimination, biotransformation, internal distribution), and translate the internal concentration into toxidynamics covering alteration of cells and organs functioning that can eventually lead to a toxic effect at the organism level (e.g., mortality, reduced reproduction, abnormal behavior) then affecting the population dynamics. In for survival analysis of organisms in response to a chemical stressor, the Generalized Unified Threshold model of Survival (GUTS) is today recognized as a suitable and powerful TKTD framework incorporating two complimentary death mechanisms: Stochastic Death (GUTS-SD) and Individual Tolerance (GUTS-IT), from which a large range of existing models can be derived. Intergovernmental institutions as the OECD have acknowledged the necessity of TKTD models for ERA improvement, but while an integrative mathematical framework as GUTS offers an efficient theoretical approach, its practical use is challenging (from model implementation to parameter estimation), especially with time-variable exposure. The Bayesian approach has multiple advantages as (i) using all data provided by the experiments, (ii) taking into account the knowledge from experts and/or previous studies, (iii) being relevant for complex model with small dataset since there is no degree of freedom, and (iv) a clear handling of uncertainties by providing distributions of parameter posterior. ’nTo ease the access of Bayesian fitting of GUTS models based on ordinary differential equations, we compared several implementation of GUTS models in R. To show software tools for Bayesian inference to the widespread statistical language R (JAGS and Stan). Then, we embedded these algorithms into two R packages with the core idea to be user friendly (e.g., using experiment design to define priors). A side result is to propose a step-by-step approach to perform Bayesian statistics in ecotoxicology.

**Can TKTD-models describe and predict synergistic interactions in Chironomus riparius?**

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The azole fungicides propiconazole and prochloraz are known to enhance the toxicity of pyrethroid insecticides like α-cypermethrin during co-exposure. The development of these synergistic actions in the waterfly Daphnia magna have recently been modelled using toxicokinetic (TK) and toxidynamic (TD) models in order to describe the underlying mechanisms for the enhanced toxicity. The purpose of the current study was to predict the same TKTD framework for synergistic interactions in D. magna can be applied to the midge larvae Chironomus riparius to describe development in survival rates and the underlying mechanisms over time when co-exposed to azole fungicides and pyrethroid insecticides. Toxicity of the individual compounds was tested using a pulsed concentration response design with an initial 24 hour exposure period followed by six further recovery in clean water. To assess the coupling of the azoles and α-cypermethrin were a range of tests conducted with co-exposure to 1, 3, 10, 30, or 100 µL L⁻¹ of propiconazole or prochloraz and 2.5, 5.0, or 10.0 µL L⁻¹ of α-cypermethrin. For the TK-modelling will uptake and elimination rates of the individual compounds in C. riparius be measured to parameterize the TK-modelling describing the internal concentrations to the observed toxicity. We hypothesise that the synergistic interactions can be described and modelled by adding a synergy parameter “s” to the biotransformation rate constant for α-cypermethrin and that the value of this “s” parameter will depend on the azole exposure concentration. The preliminary results indicated time-dependent synergistic interactions in C. riparius as previously observed in D. magna, but also a higher sensitivity of C. riparius towards the fungicides with 168 h EC₅₀-values for the 24 h pulse exposure of 1.06 ± 0.27 and 0.28 ± 0.10 µL L⁻¹ for propiconazole and prochloraz, respectively. This is surprising as previous non-published data indicated that C. riparius has an approximately 10 fold faster initial elimination rate of the azoles compared to D. magna. We expect that our TKTD models will be able to explain these kinetic differences and how they relate to the observed toxicity. We furthermore hope that more of these TKTD frameworks can be applied to other chemical combinations with exposed to azole and pyrethroid pulses with varying time intervals between the pulses.

**Integration of temperature-dependent TKTD kinetics in individual-based population modelling - A case study with Chaoborus crystallinus**

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The toxicokinetic-toxidynamic (TKTD) model framework GUTS is increasingly used and becoming the standard effect model in regulatory risk assessment. However, this model is mostly used without the temperature dependency of TKTD kinetics, and effect measurements are usually performed in the laboratory at 20°C. This approach is rather unrealistic, especially in outdoor scenarios with significantly different water temperatures over the year: On the one hand, in cases with low water temperatures during autumn and winter, the toxic effects can be reduced or delayed, while on the other hand, the degradation of the substance is often slowed down, which increases exposure levels. But also at temperatures than 20°C, increased toxic effects on organisms are to be expected. In this presentation, the influence of seasonal temperatures on toxicity at the population level is exemplarily examined. For this purpose, an individual-based population model for the phantom midge Chaoborus crystallinus is used. This has been intensively tested using outdoor aquatic mesocosm studies, and has been extended to the TKTD framework GUTS, which has been then extended by a temperature dependency based on laboratory data. Temperature dependencies of lethal effects on C. crystallinus larvae exposed to the pesticide chlorpyrifos and the fate of chlorpyrifos were measured in the laboratory in the range of 4-20 °C. These data are used to parameterize the GUTS, and subsequently to simulate the population dynamics of Chaoborus under variable outdoor temperature conditions. The Chaoborus model was used with and without the implemented temperature dependency of the effect model to assess whether toxic effects on a Chaoborus population are increased or decreased depending on the temperature conditions. Therefore representative summer and winter exposure scenarios were selected.
New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment

Assessing lethal and sublethal effects from time variable exposure for different life stages with the DEB model: an example for a Pyrethroid in rainbow trout E. Zimmer, IBACon GmbH; T. Preuss, Bayer AG / Environmental Safety; S. Norman, RidgewayEco; B. Minten, ADAMA Deutschland GmbH; V. Ducrot, Bayer AG / Environmental Safety Ecotoxicology

The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynchus mykiss) using TK-7D modelling. As part of the risk assessment modelling is used as a supporting tool to back up the experimental results and as an investigation tool to better understand the mechanisms of effects of beta-cyfluthrin. Beta-cyfluthrin is acting as neurotoxicant in fish for which the severity of effect depends on the magnitude and duration of the exposure peak. To address these characteristics, the effects of beta-cyfluthrin on rainbow trout were evaluated with two independent early life stage tests (ELS): a standard Tier 1 study with constant exposure and a Tier 2c study under time variable exposure. Observed effects differed in these two studies. Under constant exposure, severe mortality and significant growth effects were observed while under peak exposure, no effects on survival were observed, and only negligible effects on growth were found. The model was successfully calibrated using the constant exposure experiment, and then accurately predicted the effects observed in the peak-exposure assay. The model gives a mechanistic fromation in the fish does not pass the threshold for an effect on survival. This helps to explain why no mortality is observed in the peak exposure experiment. The no effect threshold for sublethal effects is passed in the modelling under constant exposure, which is consistent with the observations. In the peak experiment, the duration of the effect on the feeding behaviour is insufficient to induce large effects on growth in weight or lengths, because beta-cyfluthrin is rapidly removed from the body and the fry have difficulty to cope with reduced feeding over a short period. The modelling supports the experimental finding that under realistic exposure conditions, short term effects on the feeding behaviour do not lead to growth or survival effects, and gives a mechanistic explanation for this observation. We were able to derive a mechanistic explanation for the results from laboratory experiments conducted with three different early life-stages of the trout, and for different exposure profiles to beta-cyfluthrin. The model shows that results from both laboratory studies are consistent. This validated model has the potential to be used to make accurate in silico predictions of effects on fish early life stages from time-variable exposure profiles.

Prediction of effects on chemicals on three-spined stickleback populations in mesocosms

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To improve environmental risk assessment, mechanistic models predicting the impacts of toxicants on populations such as individual-based models (IBMs) was suggested as relevant tools. Furthermore, IBMs can be coupled with DEB (Dynamic Energy Budget) models which describe physiological processes of an organism. However, the development of DEB-IBMs requires a large number of data, and the use of the population simulation models which make them difficult to build. To this aim, data from mesocosm experiments can be of great interest for developing and calibrating DEB-IBMs. One of the species that can be used in mesocosm experiments is the three-spined stickleback (Gasterosteus aculeatus). Furthermore, the ecology and biology of this teelost fish is relatively well known and a DEB model for this organisme has already been developed. In this study, we used data from several mesocosm experiments to describe stickleback populations under control conditions, and exposed to three concentrations of an endocrine disruptor, the Bisphenol A (BPA, 1, 10 and 100 µg/L). First, using two set of experiments in control conditions, different ways of integrated temperature and food data was tested in order to assess the relevance of the DEB model calibrated with laboratory data for sticklebacks in mesocosms. Then, the DEB-IBM was developed and calibrated and simulated endpoints of the population dynamics in control conditions were compared to the observed endpoints of the population dynamics in control conditions or exposed to BPA. We showed that the DEB model successfully predicted the growth of mature male and female sticklebacks for two set of experiments in control conditions. Furthermore, the calibrated DEB-IBM successfully predicted endpoints of stickleback populations during mesocosm experiments in control conditions. Indeed, the different descriptive variables of the populations (population size, male, female and juvenile frequencies, lengths and coefficient of variations) were well described and were used to compare with the endpoints of mesocosms exposed to BPA. In conclusion, simulated endpoints of stickleback populations can thus be used as a baseline to compare exposed populations to BPA in order to improve environmental risk assessment. In a second step, the DEB-IBM could be adapted in order to introduce the effects of toxicants such as BPA on the individuals and thus extrapolate the effects at the population level.

Atmospheric Microplastic’s: A novel method for the identification of microplastic’s in the inhalable size range

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Marine anthropogenic litter is a severe environmental problem. Wastes discarded or deposited in aquatic environments (including rivers, estuaries and coasts waters) usually consist of metal, glass, wood and plastic, being the 80% of these plastic wastes. One of the main issues is the extreme stability of plastic wastes. Under environmental conditions, the erosion of these materials generates smaller fragments some of them in the nano- and microscopic scale, which are known as nanoparticles (NPLs) and microplastics (MPLs), respectively. The quantitative analysis of these plastic particulate matter is particularly difficult because of their physicochemical properties (low solubility, a wide range of molecular weights, etc.) and potential contaminations sources in the laboratory. For these reasons, different approaches should be considered to find a standardised protocol for the determination of MPLs and NPLs in the environment. In this context, this study was focused on the investigation and practical comparison and combination of different analysis tools for the quantitative and qualitative analysis of MPLs/NPLs using: (1) techniques to assess the physicochemical properties such as Thermogravimetric Analysis or TGA, Differential Scanning Calorimetry or DSC, and Fourier-Transformed Infraed Spectroscopy or FT-IR; (2) quantitative and qualitative information by techniques based on direct mass spectrometric as high resolution mass spectrometry with Electrospray Ionization (ESI), Atmospheric Pressure Chemical Ionization (APCI), Atmospheric Pressure Photoionization (APPI), Matrix-assisted Laser Desorption Ionization (MALDI), Desorption Electrospray Ionization (DESI) and Direct Analysis Real-Time (DART). These studies have been carried out using as a representative polymer the polystyrene (PS), which is one of the most frequently used for plastics production. Finally, LC-APPI-HRMS complemented by other techniques such as TGA, DSC and FT-IR allowing obtaining qualitative and quantitative information about of the whole spectrum of polymers, which may be present in the environment.

Uptake and excretion of microplastic in mussel after an experimental exposure

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Filter feeding invertebrates such as mussels are especially susceptible target species to microplastic (MP) ingested. Field and laboratory studies have reported that MP are ingested by mussel. Once ingested, MP may be ejected through defection,
retained in the digestive system, and/or transferred through the haemolymph to other body tissues (translocation). However, the knowledge on the ingestion and egestion of MP and on the accumulation of MP within different organs of mussel is limited. In this context, a laboratory experiment was conducted to investigate the kinetic of uptake and egestion of MP and its accumulation in digestive gland of mussel. To this end, individual mussels, Mytilus galloprovincialis, were exposed in a volume close to two nominal concentrations (2 and 4 mmol L⁻¹). Low and High MP dose, respectively, of microalgae (MA) (Isochrysis galbana, clone t-ISO) and MP (high-density polyethylene, HDPE) of similar size (Results showed no differences between the uptake kinetic of MP and MA, indicating a similar capture efficiency and acceptability for both types of particles by mussel. After 120 hours of the exposure, mussels had ingested around 40% of the MP ingested. The highest volume of MP was taken up by the LoMP ingested and collected after 24 hours of the exposure. Then, lower volume of MP was recorded in four cases collected after 48 hours (around 20%) and 120 hours (8%) of the exposure. The diameter of the MP particles egested decreased with time. The highest particle diameter (about 9 µm) was observed in the MP egested after 4 hours of the exposure. This may be related to a size-dependent rejection of larger MP particles in pseudofaeces. Results showed that after 120 hours of the exposure the 6% and 2% of the MP ingested was accumulated in the digestive gland of mussels exposed to the Low and High MP dose, respectively. The diameter of this MP (around 3 µm) was significantly lower than that of the MP offered (8 µm) and the MP egested (6–9 µm). This suggested a specific removal through faeces of larger MP particles and the retention of smaller ones in the digestive system.

158 Analysis of tire wear particles in environmental samples using TED-GC-MS
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We developed an analytical method which allows quantifying tire wear particles in road runoff, sediments and surface waters. Tire wear particle quantification is based on elemental composition and distinct elemental ratios. The analytical method aims at i) tire wear particle enrichment using density separation followed by ii) thermal assisted acid digestion and elemental detection of sulphur and carbon. A stepwise method development including analytical methods verification by determination of the rubber content is presented. In particular, S and Zn are present in characteristic concentrations in tires. Zn and S contents were determined in 30 tire samples as an internal reference. The average S content in the analysed tires was 15400 mg/kg (± 6000 SD), while the average Zn concentration was 1350 mg/kg (± 1700 SD). The Zn/S ratio in the tires was 1.9 (± 0.9 SD). Furthermore, the developed method was applied to field samples. Samples were taken from the intake water of a treatment facility (raw water), from the sedimentation basin, the inlet of the soil retention filter as well as from the soil itself. Isolation of tire wear particles by density separation was achieved by use of a heavy liquid, sodium polytungstate mixed with MilliQ water. Separated fractions were acid digested with microwave assistance and elemental analysis was conducted by ICP-MS and ICP-OES. Elemental content of the particulate fraction in the water samples was analysed after filtration only, since the amount of solids was too low for the density separation procedure. Acknowledgement: The authors thank the BBMF for funding the MiWa project (reference number 02WRS1378H) and BWB for provision of samples.

160 Are we speaking the same language? Towards a definition and categorization framework for environmental plastic debris
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The occurrence and accumulation of plastic debris is a global environmental issue, with potential consequences affecting the economy, wildlife and human health. However, there is currently a lack of consensus on the definition and categorisation of environmental plastic debris, including macro-, micro- and nanoplastics. The lack of clarity in terminology regarding plastic debris, in particular microplastics, results in confusion and misunderstandings. This is problematic both for legislative measures as well as for general coherence and data comparability between studies. While including a common language is imperative, any definition should be well-justified as it will ultimately shape the direction of future research and legislation. To help decide whether a consensus definition and categorization framework for plastic debris is valuable and if so how this might look, the scientific community needs to engage in a critical discussion. The aim of our presentation is to foster such discourse in the SETAC community by providing impulses and sharing our thoughts rather than providing definitive answers. In our presentation, we will use a new format with two presenters jointly discussing the advantages and disadvantages of a definition. Further we will discuss our ideas on relevant components of a definition/categorization framework. To get immediate feedback by the community, we will use online polling asking specific questions to the audience throughout the presentation. This will cover opinions on the need of a definition, acceptance of certain labelling and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get an ad hoc idea on where consensus may be easy to achieve and areas which are controversial. Finally, we will present an online platform (www.microplastics.eu, currently under development) that we will use to perform a large-scale survey on a consensus definition of environmental plastic debris. In addition, the platform will host a module for discussing the questions mentioned above and a module for networking. This platform can be used by the audience and the wider community to further discuss the impulses we give and share their opinions and input.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (III)

161 Behavioral and physiological responses of bicolor damselfish and mahi-mahi to offactory cues following crude oil exposure
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In fishes, olfactory cues provide information about predators, prey, and conspecifics that is crucial to survival; however, olfactory sensory neurons are directly exposed to the environment and are susceptible to damage from aquatic contaminants. The 2010 Gulf of Mexico oil spill overlapped with the habitat of
pelagic and reef fishes, including mahi-mahi (Coryphaena hippurus) and bicolored damselfish (Stegastes partitus). To date, within the marine teleost group, nothing is known about how crude oil exposure affects the detection of olfactory cues or if crude oil can be detected and avoided. To address these questions, the time that control and oil-exposed bicolored damselfish spent in a chemical alarm cue and the time that control and oil-exposed mahi-mahi spent in diluted crude oil was examined using a two-channel flame sensor system. The alarm cues consisted of a chemical component in the stimulus that was distinct from the crude oil. Alarmed damselfish spent a longer proportion of time in the dilute crude oil than the control fish (p < 0.01). Moving forward, an electro-olfactogram technique will be used to measure the generator potential from the olfactory epithelium of bicolored damselfish and mahi-mahi to detect the response to olfactory cues following oil exposure. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Environmental Risk (RECOVER).

162 A wide range of endpoints are impacted by oil exposure in early and later life stages of marine fish M. Grosell, J.D. Stiegelitz, RSMAS University of Miami / Marine Biology and Ecology; R.M. Heuer, University of Miami / Marine Biology and Ecology; C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L. Schlenker, RST, CAS exposed fish. Such reductions in cardiac contractility are likely related to impaired cellular calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

163 Investigating the endocrine disruptive and genotoxic potential of crude oil samples using adapted in vitro toxicity tests S. Johann, Institute for Environmental Research RWTH Aachen University; L. Nuesser, RWTH Aachen University, Institute for Environmental Research / Department of Ecosystem Analysis; L. Spencer, Institute for Environmental Research RWTH Aachen University / Department of Ecosystem Analysis; D. Altin, BioTrix; H. Hollert, RWTH Aachen University / Institute for Environmental Research; T. Seiler, RWTH Aachen University / Ecosystem Analysis In case of an acute oil spill the decision on optimal response techniques to achieve the best environmental benefit is based on important knowledge about regional ecosystem function. Even adult marine fish are sensitive to brief, low-level oil exposures, showing reduced aerobics scope and swim performance. The lower swim performance in adult oil-exposed fish with a normally developed heart, is due to reduced cardiac output driven by reduced stroke volume. Work on isolated cardiac myocytes show that sarcomeere shortening upon electrical stimulation is reduced by acute oil exposure which likely explains the reduced stroke volume observed in the fish. Such reductions in cardiac contractility are likely related to impaired cellular calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

164 Impacts of Oil Exposure on Mahi Embryos C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L.E. Sweet, Environmental Protection Agency USA; E.M. Magee, University of North Texas / Department of Biological Sciences; J.D. Stiegelitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; A.P. Roberts, University of North Texas / Department of Biology Institute of Applied Science; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology The Deepwater Horizon spill coincided with the spawning window of many ecologically and economically important fish species, such as mahi-mahi (Coryphaena hippurus). Aside from the acute mortality elicited by this event, additional sublethal effects may have imparted more subtle yet ecologically significant consequences on populations of pelagic fishes as a whole. The presence of estrogenic compounds in oil is critical to survival, and aids in promoting dispersal by facilitating drift through ocean currents and positioning newly hatched larvae in the upper water columns where planktonic food is plentiful. We found that co-exposure to oil and additional environmentally relevant stressors, such as high temperature and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Furthermore, the negative buoyancy was coupled with significantly faster sinking rates and increased energy depletion, likely resulting in detrimental consequences for these developing fish. The mechanisms behind untimely buoyancy change are unknown, but our findings suggest a behavioral avoidance response as well as an inability to maintain buoyancy due to diminished energy reserves. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).
microRNA and messenger RNA networks in early life stages of pelagic and nearshore fish species exposed to Deepwater Horizon oil

D. Schlenk, University of California-Riverside / Department of Environmental Sciences; G. Xu, UC Riverside / Department of Environmental Sciences - Developmental cardiotoxicity in a common fish species was observed in a number of fish species following exposure Polyaromatic hydrocarbon (PAH) or oil. While many PAHs elicit cardiotoxicity through activation of the aryl hydrocarbon receptor (AhR). Additional pathways of toxicity have been observed including downregulation of genes that regulate potassium and calcium channels in embryonic and larval stages of development. While functional inhibition the channels has been observed following exposure to oil and non-AhR activating PAHs, mechanisms associated with downregulation has not been observed. MicroRNAs (miRNA) play key roles in a diverse number of biological processes including heart development in vertebrates. To test the hypothesis whether miRNA changes may regulate ion channel genes, embryos and larvae of mahi-mahi (Coryphaena hippurus) were treated with High Energy Water Accommodated Fractions (HEWAF) made from source and weathered DHW oil. miRNAs and mRNA were sequenced from the same pooled animals and expression compared using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target miRNAs was consistent with pathway analysis of miRNAs, predicting disruption of cardiovascular system development after oil exposure and showed that specific miRNA–mRNA interactions may contribute to these effects (Figure 1). Oil caused an overexpression of mi-R-133a, mi-R-34, and mi-R-15b (Figure 2). Enhanced expression of mi-R-133a correlated to the decrease in the expression of KCNH2 mRNA, which controls the potassium ion transporter that has been observed to be reduced in the cardiac phenotype in multiple fish species following oil treatment. In addition mi-R-34 and mi-R-15b were also upregulated and informative analyses with miRNAs were consistent impairment of eye development (Figure 2). Ongoing analyses of dose response treatments at early hatch larval stages (48 hpf) will provide additional data that will enhance our knowledge of the impacts of oil on fish development. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

Alternative Approaches to Animal Testing for Ecotoxicity Assessments

167 Early life stages of a vertebrate species as an alternative model for the study of stressors in marine environment

M.J. Aranjo, CESAM & DeBio / APPLE; R.J. Rocha, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; C. Quintaneiro, Department of Biology & CESAM - University of Aveiro; A.M. Sousa, University of Aveiro / Department of Biology & CESAM; M. Monteiro, Aveiro University / Biology Early life stages of marine vertebrates have been scarcely used in ecotoxicity testing. The Senegalese sole (Solea senegalensis Kaup, 1858) is a common vertebrate occurring in Eastern Atlantic coastal areas. Eggs of this marine vertebrate can be obtained from aquaculture rearing facilities and used in laboratory as testing organisms. At the end of the first month of life this species completes a metamorphosis, changing from bilateral to flattened shape morphology. Early life stages of aquatic vertebrates are windows of development considered highly sensitive to anthropogenic contamination, including in marine environment. Organic compounds, such as pesticides and personal care products have been increasingly used and directly released to the aquatic ecosystems or indirectly released from wastewater treatment plants. Besides, human activities have been encouraging step toward alternatives to long time chemical safety assessment whilst reducing the number of animals used. The use of in vitro systems is more cost-effective, practical and expedient. However, it is still unclear whether in vitro methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line (Onchorynchus mykiss, RTGill-w1) exposed to a given chemical can be used as a biosensor to predict toxicity in a zebrafish embryo (Danio rerio). More specifically, we developed a regression model linking gene signatures that are independent of compound lipophilicity and predictive of toxicity. We show the ability of residual analysis to identify excess toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that cell line has the potential to replace zebrafish embryo in toxicity testing.

168 Predicting in vivo toxicity from in vitro transcriptional responses following chemical exposure

D. Basil, University of Liverpool / Institute of Integrative Biology; M. Knobel, Eawag / UTOX; A. Sawle, Cancer Research UK Cambridge Institute / Department of Systems Biology; J. Hertert, P. Antrop, University of Liverpool; Institute of Integrative Biology; K. Schirmer, Eawag / University of Zurich, Toxicology; A. Cossins, F. Falciani, University of Liverpool / Institute of Integrative Biology Alternatives to in vivo animal testing in ecotoxicology studies aim to increase the throughput of chemical safety assessment whilst reducing the number of animals used. The use of in vitro systems is more cost-effective, practical and expedient. However, it is still unclear whether in vitro methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line (Onchorynchus mykiss, RTGill-w1) exposed to a given chemical can be used as a biosensor to predict toxicity in a zebrafish embryo (Danio rerio). More specifically, we developed a regression model linking gene signatures that are independent of compound lipophilicity and predictive of toxicity. We show the ability of residual analysis to identify excess toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that cell line has the potential to replace zebrafish embryo in toxicity testing.

169 Combining computational modelling with in-vitro cellular responses in order to predict chemical impact on fish growth

K. Schirmer, Eawag / Environmental Toxicology; H. Mottaz, R. Schoenenbauer, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Stadnicka-Michalak, EPFL Swiss Federal Institute of Technology / Environmental Toxicology A paradigm shift in chemical risk assessment is needed due to the time-consumption and ethical controversies of current chemical testing on animals. In our project, we propose that the chemical effects on cell population growth, measured over few days, can be used as proxy for chemical impact on fish growth, which needs weeks to occur. In particular, we linked information on the proliferation and survival of a fish gill cell line (in vitro) to the effect of chemicals on fish growth (in vivo). Research was divided into two phases. In the first phase, we have tested in vitro several chemical concentrations that correspond to those used in in vivo experiments to confirm the reliability approach. Together, these results indicate that no prior knowledge about chemical concentrations tested in vivo was required: in vivo data were needed only to validate the model but not to decide which chemical concentrations should be tested in vitro. More than ten organic chemicals (including fungicides, herbicides, insecticides, industrial compounds and pharmaceuticals) were tested for different fish species (rainbow trout, fathead minnow and zebrafish). The results indicate a very good agreement between measurements and predictions determined for different species of fish, being exposed in vivo from 7 to 62 days, depending on the species and test design. Results moreover confirm that it is possible to predict chemical impact on fish growth without prior knowledge on concentrations that are used in in vivo studies for chemicals that do cause an effect on fish weight as well as for those that do not. Therefore, in spite of severe assumption and simplifications, combining in vitro experiments with computational modelling can result in a powerful strategy for screening chemicals to determine their effects on fish. In addition, considering the simplicity, rapidity and low costs of this approach, we believe that it can be an encouraging step toward alternatives to long-term whole organism toxicity testing.

170 Ecological Threshold for Toxicological Concern (eco-TTC) - Applications for Environmental Risk Assessment in Various Contexts

M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; S.E. Belanger, The Procter & Gamble Company / TERC; J. Barron, U.S. EPA / Gulf Ecology Division; A. Cossins, University / Biology; H. Sanderson, Aarhus University / Biology; M. Sanderson, United States Environmental Protection Agency / National Exposure Research Laboratory; K.A. Connors, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.A. Bonnell, Environment and Climate Change Canada / Ecological Assessment Division; D.T. Chang, United States Environmental Protection Agency / National Exposure Research Laboratory; R.R. Otter, Middle Tennessee State University / Biology; H. Sanderson, Aarhus University / Biology; P. Wilson, SANOFI Healthcare / Sanofi-Aventis; S.A. Hughes, Shell Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; S.A. Hughes, Shell Health - Americas / Shell Health Risk Science Team; A. Kienzler, European Commission - Joint Research Centre / DG Joint Research Centre IHCPC EURL ECVAM; T.J. Norberg-King, U.S. EPA / NIEHS/NM-Continent Ecology Division; R.R. Otter, Middle Tennessee State University / Biology; H. Sanderson, Aarhus University / Biology; P. Wilson, SANOFI Healthcare / Sanofi-Aventis The Threshold for Toxicological Concern (TTC) is well-established for assessing human safety but has only recently been explored in the ecological context. Ecological Thresholds for Toxicological Concern TTC (eco-TTC) summarize the

Mexico Research Initiative. Grant No: SA-1520.
171 Mode of action diagnosis by normalized multiple endpoint assessment in zebrafish embryos

E. Teixido, Helmholtz Center for Environmental Research - UFZ GmbH / Department Bioanalytical Ecotoxicology; N. Klüver, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; D. Kerkhof, Helmholtz centre for environmental research - UFZ / Department Bioanalytical Ecotoxicology; M. Leonard, IOREAL SA; T. Kießling, Scientific Software Solutions; R. Altenburger, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology

The diagnosis of a specific or reactive mode of action (MoA) is crucial for the prediction of adverse effects using alternative test systems. While baseline toxicity can be easily predicted using regression-based QSARs, the identification of non-baseline toxicants requires assessment of endpoints that can be related to the MoA of a chemical and ultimately assign an adverse outcome pathway. Such a MoA analysis could be possible using the zebrafish embryo test (ZFT) extended by various end points including chemical risk MoAs. In the test setup, non-specific risk assessment, mixtures, product development, criteria development. This presentation will highlight the discussions and conclusions from a recent multi-stakeholder workshop, including exploration of how this approach could be applied and integrated into evaluation strategies.

172 Poster spotlight: MO158, MO159, MO190

Migratory bird species at risk - the role of pesticides and other chemicals

173 CMS talk setting the scene for the CMS working group on poisoning and outlining CMS needs in terms of scientific input from SETAC
B. Heredia, UNEP/CMS / Avian Unit

174 Main scientific gaps in knowledge of risk from pesticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
C.A. Bishop, Environment and Climate Change Canada / Wildlife Research Division

175 Main scientific gaps in knowledge of risk from rodenticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
P. Berny, VETAGRO-SUP / Toxicology

176 Main scientific gaps in knowledge of risk from Pb ammunition and shot to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
R. Croninig, Wildfowl & Wetlands Trust

177 Main scientific gaps on knowledge of NSAIDs [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
M. Taggart, University of the Highlands and Islands / Environmental Research Institute

178 Main scientific gaps on knowledge of deliberate poisoning to [migratory] wildlife globally - POSTER SPOTLIGHT MO459
M. Odino, Independent Environmental Services Professional

179 Questions and discussion

180 Regulatory view describing the extent to which [if any] regulation takes into account neighbouring county/regional use of compounds, accounts for how local use might affect migratory species, how field data on migratory species might feed into regulatory
R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit

181 Panel discussion with audience and presenters focusing on how SETAC can interact with CMS usefully to provide scientific evidence and expertise

Challenges in setting, meeting and measuring specific protection goals for plant protection products

182 Towards a more holistic environmental risk assessment approach of crop protection products as tools in agriculture
P. Dohmen, BASF SE / Environmental and Consumer Safety, Ecotoxicology

Currently, very complex risk assessment approaches are conducted for crop protection products. This is largely justified as pesticides are intentionally introduced into ecosystems and since these substances are intended to have effects on “crop pests” and side effects on non-target species cannot be fully avoided. However, doing so, we often ignore the context, the reasons why crop protection products are utilized. This ignorance can lead to failing the overall targets or lead to sub-optimal or even wrong decisions. This will be explained in more detail in the following presentation advocating for a more holistic approach in environmental risk assessment. Agriculture per se does have an impact on the environment and...
does reduce biodiversity at the sites used for food production. This, in principle, is true for any kind of agriculture. As a consequence, it is irrational to demand that agriculture, respectively the different agricultural practices, shall have ‘no impact’ on the environment. Accordingly, regulations require that ‘no unacceptable’ impact may occur. To define what constitutes an acceptable impact and what not, the Ecosystem Services concept is considered a suitable approach. This is not a call for ignoring the impact of crop protection products. However, for achieving our targets and maintaining or even increasing the sufficient local food production and their environmental impact we need to have a broader approach and evaluate the cost/benefits of all agricultural tools equally against the background of food produced per area. Scientific tools to go for such more complex holistic approaches are partly available, but more efforts are needed to develop practical and measurable concepts allowing an approach at the cross section level. In addition, the regulatory options have to be broadened from mere risk assessment of chemicals towards a landscape level assessment of food production, and risk management has to include landscape management options. Ecotoxicological research is undoubtedly important; however, in order to achieve the overall target of feeding human populations in a sustainable way and maintaining ecosystem health, ecosystems contribute to identifying the services to be protected and how should preferences be assessed? These questions are particularly pertinent when considering the role of the general public in protection goal prioritization. Here we use information from case studies in the UK and China to investigate the importance of: who you ask (do different sections of society have different preferences?); what they know (how does prior knowledge influence preferences?); how preferences are assessed (e.g. stated v revealed preferences). We demonstrate that all three factors can have an impact on which freshwater ecosystem services are preferred by the general public and therefore should be prioritize for protection.

184 ECPA over-arching Specific Protection Goals proposal for EFSA Non-Target Terrestrial Plants, Non-Target Arthropods and Soil Organisms Guidance Documents based on EFSA Ecosystem Services approach K. Romijn, Bayer CropScience AG Currently there are 3 Scientific Opinions from EFSA that are waiting to be developed into Guidance Documents i.e. Effects of pesticides on Non Target Terrestrial Plants, Non Target Arthropods and Soil Organisms. Whilst each of these Scientific Opinions makes proposals for SPGs, the European Commission and Member States should agree on the on SPGs before they can be taken forward to be used in the Guidance Document development phase. The purpose of this paper is to provide industry input for consideration and discussion during this process. In an earlier EFSA Scientific Opinion it was recommend by EFSA that Specific Protection Goals (SPGs) should be based on the principle of Ecosystem Services utilising 6 dimensions: i.e biological entity, attribute, magnitude, temporal and geographical scale of the effect, and the degree of certainty that the specified level of effect will not be exceeded. Whilst this EFSA Scientific Opinion is a good basis for setting SPGs going forward, the experience with the EFSA Bee Guidance Document shows there is a need to reconsider how the principles described in this EFSA SPG Opinion are applied to SPG setting in individual Guidance Documents. In the case of the EFSA Bee Guidance SPG it was not the definition of “negligible effects” on colony strength that was the controversial issue but the translation of this into a numerical value (< 7%) without robust scientific justification. The use of 7% suggested there was data to support it but in fact it was still a judgement, i.e. it is a hidden ‘judgement’. The suggestion that there is no arithmetic relationship between large (>35%), medium (15-35%) small (7-15%) and negligible (3.5-7.5%) is in itself surprising for a biological system particularly one with complex feedback loops such as in honeybee colonies. To avoid the difficulty of selecting a specific hard numerical SPG value upon which consensus between different scientist and stakeholders is unclear it is recommended to base an expert judgement qualitative approach adapting the EFSA Ecosystem Services approach. The predicted impact of any effect of a PPP on an invertebrate/plant population should be described using expert judgement, which combines the predictions of all 4 EFSA dimensions above (attribute/nature of effect, magnitude, temporal and spatial scales of effects) as well as the number and importance (eg. kingdom species) of species potentially affected, and the frequency of occurrence.

185 Protection goals for non-target terrestrial plants: Is in-field protection of beneficial weeds achievable? J. Davies, Syngenta / Environmental Safety; L. May, A. Russell, A. Seville, D. Stock, Syngenta EFSA’s Scientific Opinion addressing the state of the science on the risk assessment of plant protection products for non-target terrestrial plants (NTPPs) was published in 2014. The Opinion defines non-target plants as all plants growing outside fields and those growing within fields that are not the intended pesticide target. It also states that non-crop plants growing in in-field areas provide ecosystem services including food web support, aesthetic value, genetic resources and endangered species, which require protection from the adverse effects of plant protection products. As such, the Opinion advocates the protection of plant species growing in-field that under current agricultural practice would be considered target weeds, as well as non-crop plant species growing in cross sections of landscapes. The protection of non-crop plants growing in-field, have been discussed in various stakeholder workshops and publications. Proposed options for protecting in-field ecosystem services include (a) compensation mechanisms whereby designated areas are set aside specifically for NTPPs, and (b) beneficial weed protection, which involves the control of those weed species that compromise crop yield while not affecting other species that are considered to have ecosystem service value. This second option relies upon the availability of highly selective herbicides and/or other methods of selective weed control. In order to inform this debate, the feasibility of beneficial weed protection will be considered from three perspectives: (a) issues relating to the definition of beneficial weed species (b) potential agronomic consequences of protecting beneficial weeds and (c) challenges facing the landscape conservation and promotion (e.g. water purifying microbial communities), ‘supporting services’ (e.g. organisms contributing to nutrient cycling) and ‘cultural services’ (aspects of the water landscape and conservation of natural landscapes). To this aim, a literature review will illustrate that the feasibility of protecting weeds in-field requires investigation of complex species definitions and agronomic consequences while the discovery and availability of new herbicides with the required selectivity is considered unlikely, particularly under the current regulatory framework in the EU.

186 Specific Protection Goals and the Assessment of Key Drivers in the Aquatic Environment: Are we doing the right thing? R. Benstead, Fera Science Ltd. / Centre for Chemical Safety and Stewardship; D. Phillips, Fera Science Ltd / Environmental Sciences; P. Gilbertson, Fera Science Ltd; J. Chinn, Centre for Crop Health and Protection (CHAP) When designing High Tier Assessments, the underlying concept is a progression from simple and conservative laboratory exposures, towards those that more closely resemble the ‘Final Reference’ (the actual ecosystem), so that the risk assessment can be refined by reducing the Assessment Factor that accounts for uncertainty. In the aquatic environment, the focus of High Tier Assessments should not be on aquatic Protection Goal, but rather the different ecosystem services provided by non-crop plants growing in-field, have been discussed in various stakeholder workshops and publications. Proposed options for protecting in-field ecosystem services include (a) compensation mechanisms whereby designated areas are set aside specifically for NTPPs, and (b) beneficial weed protection, which involves the control of those weed species that compromise crop yield while not affecting other species that are considered to have ecosystem service value. This second option relies upon the availability of highly selective herbicides and/or other methods of selective weed control. In order to inform this debate, the feasibility of beneficial weed protection will be considered from three perspectives: (a) issues relating to the definition of beneficial weed species (b) potential agronomic consequences of protecting beneficial weeds and (c) challenges facing the landscape conservation and promotion (e.g. water purifying microbial communities), ‘supporting services’ (e.g. organisms contributing to nutrient cycling) and ‘cultural services’ (aspects of the water landscape and conservation of natural landscapes). To this aim, a literature review will illustrate that the feasibility of protecting weeds in-field requires investigation of complex species definitions and agronomic consequences while the discovery and availability of new herbicides with the required selectivity is considered unlikely, particularly under the current regulatory framework in the EU.

187 Is “biodiversity” a measurable study endpoint? E.M. Bakker, Eurofins-ITG, Berlin, Germany The general protection goal addressed by current and future risk assessment schemes for Plant Protection Products is Biodiversity. In addition to this there are specific protection goals that may conflict with the general protection goal. Specific protection goals are generally phrased in terms of Ecosystem Services and expressed in human currency there is a risk that economic motives may prevail in their prioritization. After all, who is to judge e.g. whether preservation of pest control capacity outweighs the preservation of aesthetic value? Biodiversity is a concept with many facets and the quantification of biodiversity is no straightforward exercise. A vast array of indices exists (see e.g. Maguran 2004)
and not a single one would capture the essence on its own. The two basic parameters involved in biodiversity measures are the number of species and their abundance. Their correct estimation is core to biodiversity assessments and their balance describes community structure in terms of e.g. dominance, evenness and diversity. Similarity indices have been developed that enable the comparison of (sub)habitats, which seems a promising lead to assessing effects on biodiversity in experimental designs. With this contribution we explore different approaches to quantifying effects on structure and function. A field-initiated reduction rate of contaminant degradation products in an experimental setting. We apply and compare multivariate statistical approaches, similarity indices and a combination of univariate statistics and species richness assessments and discuss how these findings may address the general issue of effects on biodiversity.

Innovative techniques for enhancing and monitoring microbial activities in situ remediation of contaminated sites

188 Evaluation of plant-driven bioaugmentation of soil microbiota for the setup of a site-tailored rhizoremediation process in a historical PCB-polluted soil L. Vergani, University of Milan / DeFENS; F. Mapelli, University of Milan-DeFENS / Department of Food, Environmental and Nutritional Sciences; E. Terzaghi, University of Insurbia (Como) / Department of Science and High Technology, Como; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; O. Uhil, University of Chemical and Pharmaceutical Sciences, Milano; E. Zaratini, C. Morosini, University of Insurbia / DSAT; A. Di Guardo, University of Insurbia / Department of Science and High Technology; S. Borin, University of Milan / DeFENS

The Site of National Priority (SN) Brescia-Caffaro is a highly polluted area in Northern Italy presenting mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). In order to evaluate the bioremediation performance of plant species and bioaugmentation treatments for the development of a suitable rhizoremediation strategy, an experimental trial including ten vegetated treatments and their non-plant controls was set up for 18 months in greenhouse conditions. Molecular fingerprinting was applied to unveil the ability of different plants/soil treatments to shape the structure of soil microbial communities. The results showed a succession over time in both bacterial and fungal assemblages. Only the diversity of the bacterial community was, nevertheless, significantly and differentially influenced according to the applied treatment. The stimulation effect on the organic matter hydrolytic activity of the soil microbiota was evaluated using fluorescein diacetate as a proxy. All the vegetated treatments showed a significant increase in activity after 18 months from planting, demonstrating effective bioaugmentation of the soil bacterial communities, putatively enhancing their degradation capacity and, consequently, sustaining rhizoremediation. Aiming to select bacterial strains to be exploited for autotrophic bioaugmentation coupled to rhizoremediation, we established a collection of isolates from the soil biostimulated by Phialitis arundinacea. This species cultivated in conditions of redox cycle showed to stimulate the highest increase in soil microbial activity after 3 months from planting. Moreover, the 18-month bioaugmented soil was incubated with 14C-labelled 4-chlorobiphenyl, the production of 14CO2, indicated metabolic activity of biphenyl and possibly the presence of PCB-degrading populations. All the isolates were identified as Actinobacteria and were characterized for PCB-degradation and plant growth promotion. In particular, three Rhodococcus sp. strains significantly promoted lateral root development in the model plant Arabidopsis thaliana and depleted PCBs from the cultivation medium according to the results of a resting-cell assay, thus representing ideal candidates to sustain PCB-rhizoremediation through a site-tailored bioaugmentation approach.

189 Enhancement of Biological Reductive Dechlorination by in situ Adsorption onto Colloidal Activated Carbon: from the Lab to the Full Scale Application M.P. Papini, F. Arjmand, Università La Sapienza / Chemistry; P. Ciampi, C. Esposito, Università La Sapienza / Department of Earth Sciences; M. Carboni, P. Goria, J. Birstingl, Regenesis Ltd; A. Franzetti, University of Roma “La Sapienza” / Chemistry; F. Aulenta, National Research Council / Water Research Institute (IRSA)

A major share of world energy production, derives from fossil fuels, such as oil. According to OPEC (Organization of the Petroleum Exporting Countries), world oil demand growth is expected to rise by 1.53 mb/d in 2017. The large-scale use and countless applications of petroleum compounds, frequently lead to environmental contamination, as a result of accidents or emission. Accidental petroleum spills may result in severe environmental problems, thus reducing the development of appropriate and implementation of suitable remediation strategies. In recent years, microbial electrochemical technologies (MET) have attracted considerable attention as an effective and sustainable remediation technique. In MET the microorganisms catalyze oxidation or reduction reactions by using solid-state electrodes as terminal electron acceptors or donors. The discovery that bacteria-based electrodes can be used as terminal electron acceptors in the anaerobic oxidation of a variety of organic substrates has raised the potentiality that they could be employed in-situ to facilitate the anaerobic oxidation of environmental contaminants, such as petroleum hydrocarbons in soils and groundwater. Here we describe a novel bioelectrochemical reactor configuration, named the “bioelectrochemical well”, that is suitable for in-situ treatment of contaminated groundwater. A lab-scale prototype of the “bioelectrochemical well”[[1]] has been realized and operated in a continuous-flow regime using first tolune and then a mixture of BTX as model contaminants. The performance of the bioelectrochemical reactor was characterized in terms of degradation rate and yield. GC-MS analysis was also carried out in order to shed light on the “electrogenic” pathway of contaminants biodegradation. This study was financially supported by Fondazione Cariplo in the framework of the project BEyERAGE - Bio-Electrochemical Remediation of Groundwater plumes (2015-0195).[[1]] [1] Palma E., Daghio M., Franzetti A., Petrangeli Papini M., Aulenta F. The bioelectric well: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. Micro Biotechnol., 2017. doi: 10.1111/1751-7915.12760.

190 Identification of major HMW-PAH degrading communities during active bioremediation of a PAH-contaminated soil J. Vila, Instituto de Recursos Naturales y Agrobiología; M. Grifoll, Universitat de Barcelona / Dept. Genètica, Microbiologia i Estadística; M. Aitken, University of North Carolina / Environmental Sciences and Engineering; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquímica y Conservación del Suelo

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) in soils is generally constrained by their low availability to microbial communities. As a result, a reactivation of unexpected PAH-degrading communities of PAH-contaminated soils, with a major composition in high molecular weight (HMW) compounds (four or more rings). We analyzed the active microbial processes associated with the dissipation of PAHs during a lab-scale bioremediation of a creosote-contaminated soil. Treatment under stimulated conditions resulted in an extensive reduction (95%) of the total PAH concentration. Low molecular weight (LMW) compounds (2 rings) were mostly depleted during the first month of incubation. In contrast, degradation of HMW-PAHs started thereafter following biphasic kinetics. Despite the 16S rDNA gene copy numbers (bacterial abundance) remained constant throughout the 5-month treatment period, the number of 16S rDNA gene transcripts (bacterial activity) dramatically increased (from 10^5 to 10^10 copies/g dry soil) during the initial 45 days, associated with major PAH removal. 16S rDNA gene sequencing revealed distinct gene profiles for both creosote and creosote compounds that evolved with time. Gene expression analysis of ring hydroxylating dioxygenases, together with changes in pyrosequencing libraries, identified members of Pseudomonas as the main LMW-PAH degraders. In contrast, dioxygenases of
Gram-positive bacteria, associated to *Mycobacterium*, were mainly active during the last two months of incubation, when only residual fractions of HMW compounds were degraded. Community analysis during the period of major HMW-PAH removal identified members of the recently described order *Imunnidosilibacterales* and members of *Sphingobium* as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of *Sphingobium* were major phytopotypes and constituted the major autotrophic fraction, while members of *Imunnidosilibacterales* completely dominated in incubations with 1°C-pyrene and 1°C-benz[a]anthracene. Interestingly, members of *Mycobacterium*, traditionally associated to HMW-PAH degradation were not detected in either of the incubations. Our results indicate the minor contribution of *Mycobacterium* to the degradation of the more labile fraction of HMW-PAHs. Their increase in activity during the late incubation phase, when degradation kinetics were drastically attenuated, suggested their potential action on the residual fraction of contaminant.

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**Stable Isotope Raman Microspectroscopy and Surface-Enhanced Raman Scattering: Analysis of Microorganisms at Single Cell Level**

N.P. Ivleva, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry; R. Weiss, M. Seidel, Technical University of Munich; R. Niessner, Technische Universität München / Chemistry Department, Chair of Analytical and Water Chemistry; M. Elsner, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry. Microorganisms play a vital role in most ecosystems. They are essential for global biogeochemical cycles and for biodegradation of soil and water pollutants. Therefore, it is crucial to develop reliable and sensitive methods for the detection, discrimination and identification of microorganisms as well as for analysis of their activity. Raman microspectroscopy (RM) in combination with a stable isotope approach (SIRM) is an emerging tool for the nondestructive characterization of the molecular and isotopic composition (due to a red-shift in Raman spectra for heavier stable isotopes) of microorganisms at the single cell level. [1-3] SIRM allows for in situ investigations of ecophysiology and metabolic functions of microbial communities. Furthermore, the sensitivity of RM and SIRM analysis can be significantly improved (in the range of 10−6 – 10−8) due to surface-enhanced Raman scattering (SERS), e.g., by using Ag nanoparticles synthesized in situ. In contrast to RM and SIRM (where whole-organism fingerprints for bacteria are obtained), SERS is more selective and provides information on cell surface substances. We applied SIRM and SERS for analysis of unlabeled, 13C- and 15N-labeled single bacterial cells. [4-6] Single cell SIRM analysis was carried out for the *Delaglaesinobacterium sp.* strain N47; a strictly anaerobic sulfate-reducer, degrading the recalcitrant environmental pollutant naphthalene. For the 13C-labeled N47 cells peak pattern from isopentolises of phenylalanine with 0, 2, 4 and 6 13C atoms was found even though this strain is a strict anaerobe growing on 13C-naphthalene. Additionally, our results suggest an incorporation of hydrogen carbonate from the medium into biomass during growth of strain N47 on naphthalene. Furthermore, SERS analysis of *E. coli* revealed that the SERS signal intensity is dependent on different factors (storage time, presence of D-O) and can reflect the metabolic activity of cells. Our findings can open new possibilities for the application of SERS (in combination with a stable isotope approach) to probe for the activity of protein degrading microorganisms at the single cell level. [1] Berry B, et al. 2015. Proc Natl Acad Sci USA 112: E194–E203. [2] Wang Y, et al. 2016. Curr Opin Biotechnol 41: 34–42. [3] Ivleva NP, et al. 2015. Anal Chem 87: 6622–6630. [5] Kubyck P, et al. 2016. Analyst 141: 2874–2878. [6] Weiss R, et al. in prep.

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**Flux chambers data for the estimation of the biodegradation rate in the subsurface at hydrocarbon contaminated sites**

I. Verginelli, University of Rome Tor Vergata / Department of Civil Engineering and Computer Science Engineering; R. Pecoraro, Versalis; R. Basciocechi, University of Rome Tor Vergata

The occurrence of aerobic biodegradation in the subsurface by ubiquitous soil microorganisms has been demonstrated in many cases eliminating the emission of petroleum hydrocarbon vapours from contaminated soil or groundwater on outdoor and outdoor air quality. The occurrence of natural attenuation in the subsurface is generally evaluated by employing multi-techniques aimed at estimating the emission rate of contaminants detected in the subsurface (soil and/or groundwater) and the effective biodegradation rate of the contaminants measured using dynamic flux chambers installed at ground level. The reliability of this approach was tested in a versalis site characterized by the presence of BTEX in soil and groundwater, using dynamic flux chambers. The site is characterised by the presence in the subsurface (mainly in groundwater) of BTEX and light petroleum hydrocarbons. The flux of volatile organic compounds (VOCs) from the subsurface was estimated using 14 dynamic flux chambers, by measuring with a canister the concentration of vapours collected over a period of approximately 6 hours. Before starting the measurement, the achievement of steady-state conditions inside the chamber was assured by purging at least 4 to 6 chamber volumes with an inert gas. The measurement sampling points were repeated in 4 seasonal campaigns. The obtained results highlighted that the traditional methods based on the application of a non-reactive diffusive model with the concentrations measured in the soil and/or groundwater can lead to an overestimation of the emission rates of BTEX from the subsurface in some cases up to 4 orders of magnitude. Furthermore, the BTEX loss rates for the investigated site were found to be up to almost 0.5 kg/year/m2. These rates are in line with the values reported in the recent literature for natural source zone depletion.

New frontiers in Life Cycle Inventory data collection and modelling

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**The end of an era: is data and model exchange across LCA software tools finally possible?**

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In the context of the Environmental Footprint (EF) pilot phase, the European Commission requested the development of 70 representative products/organisations (RPs/ROs) so they are consistent with the requirements of the final product environmental footprint category rules (PEFCRs) and organization environmental footprint sector rules (OEFSRs), they use the prescribed EF-compliant secondary datasets, and can be made available for free to any user applying a PEFCR/OEFSR and are easily usable in the major existing LCA software tools. An implicit prerequisite is that software tools give equal results when calculating the impact of the same RPs/ROs. At the start, a document was established that defined the minimum requirements as well as the vetoes for modeling. This way, potential problems for implementability of the models in the different software tools were identified and their use was banned. Five software tools were included, GaBi, openLCA, RangelCA, SimaPro, and Umberto. The next step was to test the EF impact assessment (IA) results of all EF-compliant secondary datasets. This way, differences coming from their implementation or of the EF IA method could also be identified before testing the results of the models. Furthermore, the development of an extension to the International Reference Life Cycle Data System (ILCD) format (eILCD) format enabled importing and exporting models between software tools. Finally, the models developed for RPs and ROs will be tested in the five software tools. The problems faced in importing, calculating and comparing the results of the developed models in the different software tools together with suggestions to solve the issues were shared among the software tool developers. Some claim different results in different software tools used, often generally pointing to different “software”, without being more specific. The reason may be rather bound to methodology, age, version, flow list and import-export-interface aspects, or even a combination. This work is the basis to enable the reduction of software tool bias and the comparability of results.

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**LCA using real time information: the case of DEA-enabled monitoring of WWTP lifecycle environmental performances**

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Life cycle assessment (LCA) is undergoing the effects of a data abundance era, which poses old (data storage) and new (data mining, computational speed) challenges. The deep integration of Internet of Things (IoT) in product development and use oriented manufacturing systems has enabled a Big Data support for modeling along the entire value chain, and the emergence of open standards and open-source shared vocabularies. However, how to use this huge amount of data in a consistent way to obtain more reliable results in LCA is still not an easy task. In the case of WWTPs, data coming from sensors installed in many wastewater treatment plants (WWTPs) should theoretically enable daily benchmarking, ultimately allowing faster correction actions, when needed. However, WWTPs data still finds very limited use and is often simply stored. The aim of this work is to showcase an application of...
temporally differentiated LCA performed with real-time high frequency data and present a methodology for the on-line assessment of the shift in the performance of WWTPs. The implemented methodology performs a DEA-based benchmark coupled with LCA to evaluate the environmental impacts linked to the operation of a WWTP. A web application of the system is currently being developed using the Shiny R package. It will enable plant managers to calculate and visualize LCA results in real time by modifying customizable parameters.

196 Enhancing Land Use Change modelling with IO data
J. Schmidt, Aalborg University / Department of Planning; M. De Rosa, BONSAI / Agroecology

Land Use Changes (LUC) are responsible for around 11% of global GHG emissions, nearly the same as the transport sector. This is about half of the GHG emissions from coal-based electricity production worldwide. Nevertheless, LUC are often excluded from LCA studies because ascribing the LUC to their drivers distinguishing between production sectors is challenging and requires a complex global inventory data modelling. In order to address this, 2-0 LCA consultants has been developing a model for indirect LUC (iLUC) modelling in LCA since 2011 as part of a crowdfunded project. Recently, the model has been integrating into the multiregional hybrid Input-Output model EXIOBASE, thus providing an unprecedented level of detail in iLUC modelling. Differencing between use of land among regions of the world is based upon information on potential land productivity in different locations. The IO data allow identifying the land supplied by each country to the rest of the world with land use trends. The agricultural and land use module in EXIOBASE make use of FAOSTAT data, which provide time series on area and production per crop. The data allow modelling the global supply of land to the global market for land, distinguishing between land expansion (land transformation) and land intensifications (increased production per unit of land). The land transformation and intensification LCA activities are populated with data on carbon stocks of different land use types in all countries, and time series of fertiliser use in all countries. The current version of the model (version 4.3) includes the following elementary flows: emissions of CO₂, N₂O, NOₓ, NO₃⁻, NH₄ and resource inputs of accelerated denaturalisation caused by transformation of land. The iLUC model can be combined with any life cycle impact assessment (LCA) model. Overall, the results show that for agricultural crops, iLUC increases the GHG emissions with 100-200%, for beef cattle 20-60%, for pigs 40-80%, for dairy products 40-60%, for wood products 50-300%, and for primary plastics 2-15%. The model is location agnostic and can be applied to any decision-making context concerning long-term effects of small-scale changes. The iLUC framework is now integrated in the global EXIOBASE model, thus accounting for all crops in all countries in the world. It has already been applied to more than 50 LCA studies and on several product categories.

197 WSmix: a globally regionalised Water Supply mix framework with current and prospective databases for use in LCA
S. Stickler, ITC 91, IITAP-ELSA; L. Nigro, IITAP-ELSA-PACT; M. Núñez, TU Berlin / Sustainable Engineering; E. Loiseau, Iristea; G. Junqua, Ecole des Mines d'Alès / LGEI; A. Sferratore, Société du Canal de Provence; Y. Penru, SUEZ groupe / CIRSE; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Iristea - UMR ITAP

Freshwater comes from different sources that are unevenly distributed in the world and different water users (e.g. domestic, agriculture, industry) need different water qualities provided by local (surface, groundwater, rain), external (inter-basin transfers) and alternative sources (e.g. sea water). Water from these sources are withdrawn and processed via water technologies using the local electricity mix. The combination of water sources and technologies results in a regional water supply mix (WSmix) for each specific use. Current LCI databases do not include these mixes when modelling processes leading to a poor representation of water supply systems and related environmental impacts in LCA. Furthermore, changes in water sources, caused by changes of climate and socio-economic factors, will occur in the future. These changes should be considering in LCA of products or infrastructure with long lifespans. This work aims to develop a WSmix framework for modelling current WSmix (WSmix) and an inventory database for direct use in LCA. To demonstrate the relevance of including WSmix and P-WSmix in LCI databases, case studies have been conducted. To develop the WSmix framework, system boundaries have been defined and variabilities in classification and terminology of water sources and users have been harmonized. A WSmix database for different users has been developed and a technological matrix has been established to link water sources to water production technologies and energy use. To develop the P-WSmix, a methodology based on algorithms enabling to obtain prospective WSmix (P-WSmix) is proposed. Data on water demand and water availability projections for different scenarios and time horizons have been used. The WSmix includes a framework, a WSmix database and technological matrix. The P-WSmix includes also a framework, a P-WSmix database and electricity mix and technology evolutions. The WSmix database covers 93 countries at different spatial scales for various users. The P-WSmix covers 73 countries at national scale for two users under different scenarios and time horizons. It has been shown that the environmental impacts of supply public water are highly dependent on the country and change over time. The inclusion of WSmix and P-WSmix in LCI databases is relevant for a more consistent water-use related impact assessment and for the LCA of infrastructures or products with a long life span.

198 The evolution of database- and tool development for Agri-footprint
B. Durlinger, L. Kuling, Blonk Consultants

From performing individual Life Cycle Assessment (LCA) studies for specific products, the field is moving towards automated LCAs for full product portfolios and tool and database development. This ongoing evolution is a result of the increased quality and availability of background databases as well as an increased acceptance of LCA as the measurement and monitoring tool for environmental impact. However, a point has been reached where existing LCA software and data structures have become a limiting factor for further development. Therefore, we would like to present our recent developments regarding database and tool development for LCA purposes. Existing LCA software frameworks have become limiting in our database development, because they only have a limited set of calculation features and interfacing capabilities. Also, the data structure of existing LCA software has proven to be limiting. For example, there is no explicit distinction between a process, products/substances, and exchanges. This can result in loss of valuable information. Therefore, we have decided to develop our own database infrastructure and accompanying calculation and import/export modules, that provide enhanced flexibility. This allows for more freedom, we can now make our own choices on how data is stored, what types of analyses can be performed and how this information is presented to a user. In addition, we see a trend where LCA analysts are becoming more and more interested in advanced tools that utilise Life Cycle principles. For Agri-footprint 2018 we are therefore developing a completely new framework in a Python/Django environment that aims leverage the past developments of Blonk Consultants and Agri-footprint and utilise them to develop a cloud based Life Cycle Inventory datastore and calculation engine to support and improve both our internal data developments and to serve as a backbone for custom tools for users. With this presentation we hope to contribute to the advancement of LCA databases and tools by providing insight in recent Agri-footprint developments.

199 Poster spotlight: TU097, TU098

Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment

200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
E. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alaniäri, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Sciences

Concern over the impact that pharmaceuticals have on wild aquatic organisms has increased over the past decade. Laboratory studies have shown that pharmaceuticals can cause sub-lethal changes to animal behaviour and physiology; however, few studies have addressed whether effects documented in the laboratory extend to the natural environment. We exposed fish to one of two pharmaceuticals (temazepam and ibesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L; 200 ng/L, 20000 ng/L for temazepam and ibesartan, respectively). We then assessed how exposure affected fish behaviour in the laboratory (scototaxis to measure anxiety and activity responses) and in the field (downstream dispersal using PIT tags). We found no evidence that either pharmaceutical treatment affected behaviour in the laboratory scototaxis assay. In contrast, fish exposed to ibesartan extend to the field the high and low doses of temazepam dispersed faster downstream when compared to control fish. Ibesartan exposure did not affect fish behaviour in the field. Across all treatments, we also found that activity in the laboratory correlated with migration speed, indicating that fish that were more active in the laboratory also moved faster downstream in the wild. We discuss our findings in relation to differences in tissue bioconcentration for both pharmaceutical compounds in the muscle and their impact on wild fish results enrichment of measuring how pollutants affect ecologically relevant behaviours in the field alongside standard and efficient laboratory assays.

201 Exposure to the widespread androgenic steroid 17β-trenbolone alters behaviour in fish
M.G. Bertram, Monash University / Biological Sciences; M. Saaristo, J.M. Martin, T.E. Ecker, C.P. Johnstone, B.B. Wong, Monash University / School of Biological Sciences; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alaniäri, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Sciences

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Some ecosystems. Some co-waterways worldwide with virtually no knowledge of how they might affect aquatic organisms. As a consequence, increasing amounts of pharmaceuticals are released into aquatic ecosystems via effluent runoff. Hormonal growth promotants are designed to have biological effects at low doses, often act on physiological pathways that are evolutionarily conserved across species, and have repeatedly been detected in freshwater systems—on a suite of ecologically important behaviours in female eastern mosquitofish (Gambusia holbrooki). We found that fish exposed to 17β-trenbolone—were more active and exploratory in a novel environment (i.e. maze arena), while boldness was not significantly affected. Further, when tested for sociability, exposed fish were again more active and exploratory, and spent less time associating with a shou of stimulus (i.e. unexposed) conspecific females. Lastly, when assayed for foraging behaviour, exposed fish spent a greater total amount of time within a foraging zone containing an array of prey items (chironomid larvae) than did unexposed fish, entered this zone more frequently, and were more likely to feed. Further, a grazing rate of chironomids on three microalgal species, independently. Therefore, treatment-induced increases in foraging behaviour were independent on female size. Taken together, these findings highlight the potential for sub-lethal levels of veterinary pharmaceuticals detected in the environment to alter sensitive behavioural processes in wildlife across multiple contexts, with possible ecological and evolutionary implications for exposed populations.

204 Can personality influence the response to environmental contaminants? M. Oliveira, University of Aveiro; M. Sampaio, T. Santos, University of Aveiro / Biology Department & CESAM; A.L. Machado, University of Aveiro / CESAM Department of Biology; M. Barbosa, Department of Biology & CESAM - University of Aveiro / Biology; I. Domingues, University of Aveiro / CESAM Department of Biology

Stress is a determinant factor reducing animal welfare. Currently, it is recognized that animals react differently as a function of their personalities, or stress coping styles (i.e. consistency in behavioural and physiological responses across time or contexts). However, the role of personality in modulating individual response to environmental contaminants has received limited attention, despite the recognition that personality traits associated with a shy-bold continuum play an important role in animal fitness. Knowing that pharmaceuticals can interfere with personality, one question arises: what is the role of personality on animals’ response to pharmaceuticals? In this research, we investigate if treatment with pharmaceuticals could induce changes in personality traits associated with an activity level, and salmon migratory behaviour. Therefore, we investigated the effects of pharmaceutical contamination of natural systems might be much more widespread than we predict based on conventional ecotoxicological tests.
indicating increased lethargy in the flowoxetine birds relative to controls. There was no clear effect of treatment on exploratory tendency. Finally, infrared thermography showed that flowoxetine-treated birds had significantly colder legs compared with controls. This indicated that, as observed in humans, flowoxetine causes vasconstriction, which in birds will affect the ability to thermoregulate. This study provides further evidence that low, environmentally relevant concentrations of pharmaceuticals can cause subtle changes to behaviour and physiology that are likely to impair the capacity of wildlife to respond appropriately to environmental changes.

Can trends in wildlife populations revolutionise our understanding of the impacts of chemicals on the environment?

206 Does single compound risk assessment protect from mixture effects and multiple stress?

P. Von der Ohe, UBA - Federal Environment Agency / IV 2.2 Pharmaceuticals

There is clear evidence that stress from anthropogenic activities can have profound local and regional effects on aquatic communities. To what extent chemicals are responsible remains largely unknown. The question whether a single compound risk assessment can protect from further deterioration of our water resources is discussed in the light of current mixture toxicity frameworks and multiple stress considerations. Here we present a European wide risk assessment of organic chemicals, based on regulatory monitoring data at about 6,000 monitoring sites available from the German Environment Agency (EEA). For the more than 600 mostly industrial substances, including many detergent ingredients such as benzotriazol, the available quality standards were collated or predicted from reliable QSAR models. Results showed that organic chemicals are likely to exert long-term effects on sensitive species in more than 5% of the sampling sites with multi-year samplings. In this study, we analyzed the potential cumulative effects of multiple exceedances of the PNEC in consecutive years as well as from various substances. The monitoring programs considered in this study often include only a subset of the chemicals expected. Hence, our assessment is likely to underestimate the actual risk. Nevertheless, the results show that multiple exposures at each site is rather the rule than the exception. Finally, we discuss whether chemicals from WWTP have significant effects on aquatic invertebrate communities as compared to effects from local habitat. For that purpose, we analysed two data sets on macro invertebrate communities where we have a) similar chemical stress, but differing habitat quality and b) similar habitat quality but differing chemical stress. The results indicate that in direct comparison, chemical stress induced larger effects as compared to habitat degradation. Our results therefore clearly indicate that chemical pollution is still a large-scale environmental problem that requires far-reaching, holistic mitigation measures to preserve and restore ecosystem health. It also suggests that current risk assessment approaches on a substance by substance bases are likely not protective for the environment.

207 Threshold trends in wildlife taxa: challenging and evaluating our chemical- and environmental risk assessments of chemicals and their mixtures

L. Postma, RIVM / Centre for Sustainability, Environment and Health; D. De Zwart, DiDZ Ecotoxicology / Centre for Sustainability Environment and Health; J. Postma, Ecofide; M.C. Jzip, RIVM / Centre for Sustainability, Environment and Health

“Big data” are a potential goldmine for studying and contextualizing chemical and environmental risk assessments, as they enable relating predicted risks to observed impacts. This can confirm or challenge our chemical risk assessments, by checking whether Environmental Quality Standards provide sufficient safety, and whether or not mixture exposures cause problems not captured in the widely used ‘single-chemical plus safety factor’ approaches. Digging the goldmine asks for – first – data collation, and then: a powerful design which can be borrowed from epidemiology. This presentation is a recent gold-digging trial, with surprising results. We collated biomonitoring and mixture exposure data from the Dutch Waterboards, as collected due to obligations of regulatory frameworks (such as the Dutch Environment Act). Outcomes were expressed as multi-substance Potentially Affected Fraction (msPAF-EC50) of species-specific Specific Sensitivity Distribution (SDD). Early research suggested that this proxy – higher values of which are interpreted to imply a higher potential for species loss – has a gross absolute relationship with species loss in various regional studies. In the current study, we overlaid the SSD-model basis (all species are unequal in their sensitivity to exposures) with this finding, by analyzing taxa-specific threshold values. That is, we determined the taxa-specific msPAF-EC50 beyond which species abundance starts changing when toxic pressure rises, in a downwards (sensitive) or upwards (indirect opportunistic response) direction. The results show a series of species-specific mixture exposure thresholds, and an overall assemblage-level (aggregated) exposure threshold. These outcomes are compared to simpler approaches, such as quatile regression on the species assemblage level, as well as multi-stressor statistics. We conclude that the set of species-specific and assemblage-level thresholds bear important contextual information to judge our risk assessment and management foundations, be it in the realm of prospective Chemical risk assessment or of the retrospective Environmental risk assessment and management.

208 How much do improvements in wastewater treatment benefit downstream macroinvertebrate populations?

A. Johnson, CEH Wallingford / Wallingford; F. Edwards, Centre for Ecology Hydrology Maclean Building; M.D. Juergens, Centre for Ecology and Hydrology / Wallingford; H. Vincent, Centre for Ecology Hydrology Maclean Building

The River Ray, which is a small tributary of the Thames (UK), offers an unrivalled opportunity to examine the impact of changes in wastewater treatment on the resident aquatic wildlife. This opportunity exists because the waste from the 170,000 plus people of Swindon discharges into this small 12 km long waterbody, such that the downstream mean annual flow is composed of 65-80% treated effluent. The downstream monitoring sites showed a sustained improvement in macroinvertebrate diversity starting from 1991 onwards. This sustained improvement for macroinvertebrates coincided with a 10-fold drop in ammonia, halving of biodegradable organics, (BOD) and improvement in dissolved oxygen associated with the conversion of the Swindon plant from trickling filter to nitrifying activated sludge. There were no dramatic changes in metal concentrations over the key early 1990s’ period unlike the main sanitary determinants. Whilst there was no change in overall flows, winter water temperatures downstream of Swindon rose over the course of the 30 year monitoring period. We could not identify any factor that would be responsible for these changes in abundance are not known. The recovery of macroinvertebrate diversity is slow and has not yet returned to the expected range for such a river, however, it was noted that the habitat is not ideal. This project has demonstrated the immense power and value of consistent long-term parallel chemical and wildlife monitoring. Andrew C. Johnson, François Edwards, Monika D. Jürgens, Helen Vincent Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 8EB, UK ajo@ceh.ac.uk Keywords: macroinvertebrates, biodiversity, wastewater, GAC Track 7, Session 7.2 Preference Platform

209 Biometric parameters of the bream (Abramis brama) as indicators for long-term changes in environmental quality - results from the German ESB

D. Teubner, Trier University / Biogeography; M. Paulus, M. Veith, Trier University; R. Klein, Trier University / Biogeography

Fish health depends upon the macroinvertebrate community from the application of tertiary granular activated charcoal treatment (GAC) lasting from 2008 to 2014. New macroinvertebrate families appeared during this period. The steady improvement in macroinvertebrate diversity in an effluent dominated river implies that current chemicals in domestic wastewater are not noticeably harmful to these organisms. This implied that provided we can achieve a 90% percentile BOD below 5 mg/L, NH3 below 0.6 mg/L and DO above 60% saturation, aquatic macroinvertebrate diversity will steadily improve (within the limits of habitat suitability). The small river has a population of stickleback and other fish but their changes in abundance are not known. The recovery of macroinvertebrate diversity is slow and has not yet returned to the expected range for such a river, however, it was noted that the habitat is not ideal. This project has demonstrated the immense power and value of consistent long-term parallel chemical and wildlife monitoring. Andrew C. Johnson, François Edwards, Monika D. Jürgens, Helen Vincent Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 8EB, UK ajo@ceh.ac.uk Keywords: macroinvertebrates, biodiversity, wastewater, GAC Track 7, Session 7.2 Preference Platform

210 The burden of being a slow-life cycle species: freshwater fish population dynamics in France, correlations to species life traits and implications in ecotoxicology

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Population dynamics of aquatic species and ultimately their population growth rate (λ), must be known to properly define species conservation status and plan appropriate conservation actions. It is also essential to allow for inter-specific variations in demographic and life history traits influence population dynamics. For this purpose, we implemented an integrative approach focused on 18 common freshwater fish species representing 94% of fish abundance and 88% of fish biomass sampled since 1990 in 546 monitored sites in France. Abundance and biomass growth rates were estimated with space-models and fish length trends with quintile regressions. To further study correlations between fish abundance, biomass, fish-length trends and fish life traits (life history strategies, species trophic position, habitat preferences and thermal tolerance) we performed multivariate analyzes. The present work demonstrates that during the last decades, 10 species
exhibited significant decline in abundance, 2 species were in expansion and fish abundance remained stable for 6 species. The correlation between biomass and abundance growth rates was also very high (R²=0.93). The intra-specific trends in fish length over the studied period also showed a severe decrease among the largest individuals (quantile 0.75 and 0.90) and was correlated to severe biomass decline in several species. This result reflect progressive alterations in the population size / age structure suggesting that a decrease in growth and survival might be responsible of the pattern here observed. Among the demografical and ecological traits we investigated, generation time and fish maximum length were the most correlated to species population growth rates indicating the decline of slow generation time species. These results are discussed with regards to global pressures which could explain large scale decline of periodic species with a focus on chemical products which can explain body growth decrease, juvenile and adult survival alterations due to micropollutant exposures. Further attention will be paid to discuss conservation measures and life stages which should be protected in priority to favor periodic species recovery.

211 The use of natural historical reconstructions to reconstruct temporal trends of the exposure to major contaminants in different white-tailed eagle (Haliaeetus albicilla) populations

J. Sun, Antwerp university / Department of Biology; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; B. Hippe, University of Antwerp / Environment, Risk Management; G. Malavannan, University of Antwerp / Toxicological Center; J. Sondergaard, Aarhus University / Arctic Research Centre; K. Thorup, A. Tottrup, Natural History Museum of Denmark; M. Eens, University of Antwerp / Department of Biology; I. Eulaers, Aarhus University / Department of Bioscience Understanding temporal trends of persistent contaminants in wildlife is critical for the assessment of the potential associated past, present and future health risks. We have established a retrospective examination of Mercury (Hg) and several organohalogen contaminants (OHCs) in Swedish, Norwegian and Greenlandic white-tailed eagle (Haliaeetus albicilla) using body feathers obtained from natural history and ornithologist collections. We analyzed feathers for Hg, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), as well as stable carbon and nitrogen isotopes. The aims of the present study were: 1) to retrospectively reconstruct temporal trends of major contaminants in relation to anthropogenic emissions and regulations, 2) to interpret how dietary habits (using stable isotope proxies) may have affected the temporal trends, and 3) to document a potential spatial gradient from high (Sweden) to low (Greenland) anthropogenic contaminant input. Strong evidence for spatiotemporal patterns was found based on preliminary results for Hg and OHCs in the Swedish and Norwegian populations. Swedish white-tailed eagle feathers showed concentrations associated with adverse physiological effects, thus supporting the earlier observed dramatic decline in productivity. Hg concentrations were much lower in the Norwegian feathers, while the peak PCB exposure is of the same order of magnitude as the average PCB exposure in Swedish white-tailed eagles. The here presented Hg preliminary results will be complemented with data for the Greenlandic populations as well as emission and stable isotope data to disentangle the relative effects of dietary habits and anthropogenic contaminant sources.

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (I)

212 Findings of a SETAC Technical Workshop on Bioavailability-based Water Quality Criteria

C.E. Schlekat, NiPERA; K. Gallagher, U.S. EPA / Office of Water; B.A. Stubfield, Oregon State University / Environmental and Molecular Toxicology A workshop entitled “Technical Workshop on Bioavailability-based Water Quality Criteria” was held under the auspices of the Society of Environmental Toxicology and Chemistry on 3-8 December 2017 in Pensacola, Florida, USA. The goal of the workshop was to evaluate the state-of-the-science regarding metals bioavailability models and their use from a regulatory perspective. A second, but equally important, goal was to provide a scientific forum for discussions that could inform the further incorporation of bioavailability concepts into regulatory approaches for determining acute toxicity. The workshop provided the opportunity to share the state-of-the-science regarding the ability to accurately predict the toxicity of metals in the environment to aquatic organisms has increased rapidly in recent years. Workshop participants reviewed the current state-of-the-science on aquatic bioavailability information for metals and on methods to model bioavailability under a range of environmental conditions. Participants also discussed the technical challenges associated with applying bioavailability-based approaches, especially in a regulatory context. The outcome of the workshop will support expanded incorporation of metal bioavailability information into global regulatory frameworks. Approximately 40 invited scientists representing industry, government, and academia participated in the workshop. Participants were divided into five groups with each group addressing one of the following meeting objectives: Review of the state-of-the-science regarding the issue of metal bioavailability and toxicity to aquatic organisms, Determine the extent to which available biotic ligand models (BLM) multi-linear regression (MLR)-based models/or other alternative approaches offer a means for predicting aquatic toxicity and to which they are protective of aquatic life. Develop technical information regarding the type and quantity of data necessary to develop and apply bioavailability-based aquatic toxicity models, Develop recommendations for approaches to validate bioavailability-based models, and Provide recommendations for suggested measures of acceptability for bioavailability-based aquatic effects models. Workshop findings will be presented and will later be published in the form of a SETAC “Summary document” and a series of manuscripts to be submitted to a SETAC journal.

213 Modifying factors for nickel speciation and toxicity in seawater

W. Chen, Wilfrid Laurier University; S. Sherman, Wilfrid Laurier University / Biology; J. McGee, Wilfrid Laurier University / Department of Biology; R.C. Santore, Windward Environmental, LLC; T. Blewett, University of Alberta; G. Merrington, WCA Environment Limited; D. Smith, Wilfrid Laurier University / Department of Chemistry Nickel (Ni) toxicity in seawater is of increasing concern because of coastal Ni mining activities. Determining Ni speciation is vital to understanding and predicting Ni toxicity and ultimately for bioavailability based nickel risk assessment. Application of existing freshwater bioavailability based approaches for nickel in salt water predicts negligible binding of Ni to dissolved organic matter, but there are several examples of toxicity tests in natural seawater that are protective compared to artificial seawater control samples. Determining Ni speciation is determined in real saltwater samples of diverse geographic origin from the east coast of the United States and Canada. The divalent Ni free ion in these synthetics and real seawater samples was quantified using Ion Exchange Technique (IET) with Ni measured by Graphite Furnace Atomic Absorption (GFAA). The measured Ni²⁺ values were compared with model predictions (i.e. Visual Minteq) for evaluating the feasibility and applicability of the IET method for Ni in seawater. For the most part IET-measured [Ni²⁺] agreed very closely with model predictions. In the same defined solutions, 96-hour Ni embryo toxicity tests were performed for a sea urchin (S. purpuratus). The dose response curves were expressed both as total dissolved Ni concentration ([Ni]) and free Ni concentrations from IET ([Ni²⁺]). If the Ni toxicity is explained by [Ni²⁺], all the toxicity response curves of different model ligands will overlap and this was in fact observed for the majority of samples. The results of this research contribute to the development of bioavailability-based prediction models for estimating the impacts of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Vale Canada and NiPERA Inc.

214 Acute bioavailability models for nickel: Development and regulatory application

K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology; P. Van Sprang, I. Vercaigne, ARCHE; A. Peters, wca; C. De Schamphelaere, NiPERA; E. De Schauwer, Wilfrid Laurier University Chronic bioavailability models for nickel are well-established. For example, the Annual Average Ni Environmental Quality Standard (AA-EQS) under the European Union’s (EU) Water Framework Directive (WFD) is based on normalization of chronic Ni ecotoxicity data using chronic Ni bioavailability models. Acute Ni models have been developed for invertebrates, fish, and algae, but these models have not received less regulatory attention. The aim of this research was given that acute Ni toxicity can vary by greater than 17-fold for aquatic invertebrate species tested in variable water chemistries, normalization of acute Ni ecotoxicity data is an important consideration for the determination of Maximum Allowable Concentrations (MAC) under the WFD. The goal of this study was to test if the existing acute Ni bioavailability models can be used to predict acute Ni toxicity to both model and non-model species and to demonstrate how they can be applied to derived MAC values. Acute Ni ecotoxicity data (eight species from 13 different studies) were identified from the literature. Data were accepted for analysis if acute Ni toxicity for a species was tested in >2 test waters differing in physico-chemistry.
Acute Ni bioavailability models (3 invertebrate models, 2 algae models, and 1 fish model) were used to evaluate the ecotoxicity data. To simplify the normalization process, an “average animal” bioavailability model was developed using a weighted average of parameters for existing models. Because crustacea are typically among the most sensitive organisms to Ni exposure, and because the fish model did not capture pH effects on acute Ni toxicity to crustacea very well, an “average crustacean” model was developed. The model parameters for the 3 crustacean models were used to construct the “average crustacean” model. Both the “average animal” and “average crustacean” models reduced intraspecies variability considerably among the available Ni ecotoxicity data. For example, the “average animal” model predicted 98% of the 193 individual acute ecotoxicity data points within a 3-fold error, and 90% within a 2-fold error. The “average crustacean” model, although this model clearly showed a better ability to predict the effect of pH on Ni toxicity to cladocerans. The models were applied to an acute Ni ecotoxicity dataset to derive bioavailability-based MAC for European water bodies with typical ranges of water chemistry.

215 Bioavailability and bioaccumulation of uranium: From lab experiment to modelling

A. Hussen, Mines ParisTech / Hydrodynamics and reactions team (HR); M. Leemakers, Vrije universiteit Brussel / Department Analytical, Environmental and Geochemistry; M. Descostes, AREVA Mines / R&D; V. Lagneau, Mines ParisTech PSL Research University UGFS (BEES is found Variscan (t), follow team HR) Environmental regulations are becoming more and more ecosystems-oriented. In this respect, the habitat’s faunal biodiversity is targeted, meaning the contaminant’s bioavailability is taken into account. The latter depends on the ecological conditions of the aquatic system, which define the chemical speciation. For several elements, Environmental Quality Standards (EQS) and Sediment Quality Standards (SQR) have been proposed. For non-priority elements such as Uranium, EQS and SQS should be supplemented with national standards. As the bioavailable fraction in sediments is dependent on geochemical factors and sediment mineralogy, it is important to investigate the role of sediment composition on the bioaccumulation of uranium in benthic organisms. In the present study, laboratory experiments were performed on the bioaccumulation of uranium in the larvae of the non-biting midge Chironomus riparius exposed to specific mineralogical phases (pure Quartz, 3% Kaolinite/ 97% Q, 10% Siltite/ 90% Q, 10% Siltite/ 90% Q, 10% Ferrihydrite (FOH)/ 90% Q and a mixture of the 4 mineral phases (3.3% Kaolinite/ 3.3% Siltite/3.3% (FOH) and 90% Q) spiked with uranium at two different concentration levels. During a ten days’ exposure experiment, the uptake of uranium in the chironomid was investigated and the concentrations of uranium in sediment, overlying water, pore water were measured as well as the composition of major ions and physicochemical parameters. Diffusive Gradients in Thin Films (DGT) devices were deployed simultaneously to investigate the relationship with the uptake of uranium in the chironomion larval Sediment to porewater partition coefficients (Kd) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Accumulation Coefficient (BAC) was found for FOH (8), followed by quartz (4), Smectite (9) and Ferrihydrite (9) and Siltite (8) and is the lowest for the mixed composite sediment (1). DGT labile uranium porewater concentrations account for 70-100% of the uranium in porewater for all mineral phases except the quartz, where Cdet only accounts for 10% of the uranium in porewater. Uranium accumulation on the DGT units is correlated with the accumulation in the chironomids. Results obtained by lab experiments were compared with predictive models (CHESS) to model the uranium sorption behaviour and chemical speciation in the aqueous phase. These results are compared with the proposed regulations by IRSN on uranium bioavailable chemical species.

216 Empirical Investigations into the Toxicity and Bioavailability of Aluminium to Aquatic Species

B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology; A.S. Cardwell, Oregon State University / Faculty Research Assistant; W.J. Adams, Red Cap Consulting; R. Genser, GEI Consultants / Ecological Defense; R.C. Santore, Windward Environmental, LLC; E. Nordheim, Aluminium REACH Consortium Implementation of the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulation over the past years has resulted in 1: the generation of large amounts of empirical toxicity data and 2) increased our understanding of the relationships between water physicochemical parameters and toxicity. For the REACH conformity assessment requirements and the provision of data describing the chronic toxicity of regulated chemicals to a variety of aquatic organisms. To address possible data gaps in the Al database, a series of chronic toxicity tests were conducted with freshwater organisms. Aluminium toxicity is a function of its speciation and this is a function of water pH. Previous chronic toxicity tests with Al were typically conducted under acidic test conditions and few studies have been conducted at pHs more typical of natural surface waters. The studies reported here investigated the chronic toxicity of Al at pH 6.0 to 8 freshwater species. The species tested were the great pond snail (Lymnaea stagnalis), a rotifer (Brachionus calyciflorus), an aquatic oligochete (Aerolosoma sp.), a midge (Chironomus riparius), an amphipod (Hyalella azteca), an aquatic plant (Lemma minor), and two fish, the fathead minnow (Pimephales promelas) and zebrafish (Danio rerio). Chronic test durations ranged from 48 hours to 35 days. The most sensitive species was the zebrafish (10% effect concentration (EC10) of 98 µg/L total Al) based on growth effects. The least sensitive species was Lemma minor, with an EC10 of 2175 µg/L total Al as total weight. A series of chronic toxicology tests conducted with Ceriodaphnia dubia, fathead minnows, and the algae (Pseudokirchneriella subcapitata) suggest that modifying factors such as pH, dissolved organic carbon (DOC), hardness, and temperature have a large impact on the bioavailability and toxicity of Al to aquatic organisms.

217 Main factors responsible for the environmental degradation of rivers in a basin dedicated to gold mining using ecological predictive models. Case study Ponce Enriquez.

C. Sanga, Escuela Superior Politecnica del Litoral (ESPOL) / Departamento de Ciencias Quimicas y Ambientales; L. Dominguez, P. Almeida, Escuela Superior Politecnica del Litoral ESPOL / Departamento de Ciencias Quimicas y Ambientales; J.C. Pindo, M. Arias, G. Louza, Escuela Superior Politecnica del Litoral ESPOL / Facultad de Ciencias de la Tierra The irreversible effects that the environment has suffered due to anthropogenic activity has reduced the availability of water for living beings, both in terms of quantity and quality. Industrial, agricultural, mining and urban development activities have in many cases led to the generation of pollutant discharges that threaten the health of our ecosystems. The impacts of mining activity on aquatic ecosystems have been widely documented, reporting the deterioration of water quality, the impact of biodiversity, as well as the release of heavy metals of potential accumulation in organisms and subsequent biomagnification through the food chain. Although it is known that non-technical mining activity affects the environment, it is necessary to identify and prioritize those factors that relate to mining activity that have a greater impact on the ecosystem (regeneration, cyanation, amalgamation). The identification of those factors would allow environmental control authorities to prioritize management actions focused on those parameters with the greatest impact, thus mitigating the impact of this activity on aquatic ecosystems. To illustrate this, the present study conducted in the Ponce Enriquez area seeks, through the construction of predictive models based on decision trees, to discriminate those environmental factors responsible for the environmental degradation observed in rivers and streams in the study area. In order to determine the environmental quality of the sites visited, the application of the BMWP / Col index was used, which is based on the structure of the macroinvertebrate community present. Additionally, a set of environmental variables of water and sediment quality were used as indicators of environmental pressure of the activities carried out in the basin, which is predominantly dedicated to the extraction of gold. Artisanal gold mining in the Ponce Enriquez area is a social technical problem that is affecting aquatic ecosystems and the ecosystem services they provide. The main stressors of the deterioration of the ecological quality of the rivers studied are calcium, copper, the total suspended solids and the modification of the characteristics of the substrate. The impacts of mining activity on aquatic ecosystems are exacerbated by the increase in mining activity and climate change. Through the ecological predictive model it was possible to determine the permissible levels of calcium in the rivers to improve the environmental condition of 30% of the stations sampled. (Ca

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (I)

218 Closing the gap between small and smaller: Towards a framework to analyse nano- and microplastics in aqueous environmental samples

P. Bauerlein, KWR / Analytical and Environmental Chemistry; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; S. Mintenig, Utrecht University / Copernicus Institute of Sustainable Development; A. Koelmanns, Wageningen University / Aquatic Ecology and Water Quality Management; H.M. Ohlendorf, CH2M Detecting nanoplastics and determining actual concentrations and sizes of plastic particles present in the environment is a crucial issue, given the large number of plastic particles manufactured and released into the environment. Microplastics have been detected globally in various aquatic ecosystems. The determination of nanoplastics is hampered due to the high methodological challenges. But yet, its formation was proven experimentally and, for the first time, its presence in marine surface water samples confirmed. Building on those results, we further propose a framework that is able to consistently determine a broad size spectrum of plastic particles in an aqueous environmental sample. The results from initial tests confirm the general applicability of individual techniques to, firstly, sample and, secondly, detect plastic sizes and polymer types. To obtain representative results, a sampling strategy is needed to concentrate plastic particles. Crossflow ultrafiltration is applied to concentrate nanoplastics from 100 into 0.5 L and yields in a reproducible particle recovery of 54 ± 2 %. Microplastics are detected using FTIR-microscopy which is limited to a minimum particle size of 28 µm. For nanoplastics field- flow- fractionation, that reveals information on the particle sizes, and pyrolysis GC-MS, that is used to identify the polymer types, are
applied. Under the given settings the latter requires a mass of approximately 100 ng to identify polystyrene in an environmental sample by which this technique seems promising for the detection of nanoplastics. The pre-concentration by crossflow ultrafiltration reduces the determined detection limits, and enables the identification of polystyrene for an original concentration of 20 µg L\(^{-1}\) in aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional microfluorescent analysis during the analysis with FTIR-microscopy. By this, the results of spectroscopic and thermal degradation analyses (e.g. pyrolysis GC-MS) can be combined and compared.

219 Trace particulate plastic analysis in environmental systems: synthesis and utilisation of natural matrix and microplastics by C. Goedecke, F. Schmidt, M. Schmiederer, Eawag Swiss federal Institute of Aquatic Science and Technology; D.M. Mitrano, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Risk and Management Research on particulate plastic (nano- and microplastic particles and fibers) and their distribution in the environment has intensified in recent years; but truly quantitative analysis, even at the bench scale, has remained elusive in part due to the analytical difficulties in detection. Synthesizing plastic particles with a metallic, chemically entrapped tracer can provide a robust way to more easily, accurately and quantitatively detect particulate plastic in complex environmental and biological media. In this study, a suite of methods to synthesize a variety of particulate plastics of various sizes (100 nm to 1 mm), surface morphologies/charges and polymers (polystyrene, polyester, polypropylene and low density polyethylene). Each variant has an embedded metallic fingerprint (Pd, In, Au; approximately 0.5% metal/wt) which can be used to detect plastic by common analytical techniques, such as ICP-MS. To highlight the utility of this approach, dilute concentrations of particulate plastic were measured in various media including river water, municipal wastewater treatment plant effluent and wastewater sludge. Nanoplastics, for example, were detected at 3 orders of magnitude lower than concentrations of polystyrene and similar particles with a fluorescence label. After ensuring the metal tracer was stable over time, digestion methods were developed which took into consideration the specific polymer and metal in question to achieve a minimum of 85% recovery in every matrix. Furthermore, the particulate plastics synthesized were spiked into mixed liquor in batch experiments representing different stages of a municipal wastewater treatment plant to determine how various particulate plastics move through the system. In this way, some conclusions could be drawn concerning particle behaviour, aggregation and the likelihood of microplastics and the potential for microplastics to be discharged to freshwater within wastewater treatment effluent. Beyond the case study specifically highlighted here, these metal laden particulate plastics were also used in similar study facilities to test the impact of common wastewater treatment technologies on plastic interactions with organisms at trace concentrations. By using these materials, bench scale and pilot scale studies can be used as a bridge to understand the environmental processes that dominate (particulate) plastic fate, transport and interactions with biota until analytical techniques to measure native particulate plastics of small sizes and in trace concentrations have matured.

220 Detection of polymers in treated waste water using TED-GC-MS C. Goedecke, K. Altman, Bundesanstalt für Materialforschung undprüfung; C. Bannick, Umweltbundesamt; E. Kohler, Technische Universität Berlin; M. Ricking, UBA Umweltbundesamt; T. Schmitt, Berliner Wasserbetriebe; U. Braun, BAM-Freiberg; Institute of Technology; 48. SETAC Europe Annual Meeting Abstract Book

221 Soil and sludge: A time and cost-effective method for microplastic analysis of complex, organic-rich environmental matrices R. Hurley, NIVA - Norwegian Institute for Water Research; A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; M. Olsen, Telemark University College; L. Nizzetto, NIVA The very little existing research on microplastics in organic-rich substrates such as soil or sewage sludge. The organic components, as well as the complexity of the solid matrix, complicates the extraction process. No standardised methodology has thus far emerged. This study aims to establish an effective extraction technique appropriate for the monitoring of microplastic contamination in soil and sludge samples. Four main protocols (including two temperature and concentration variants) were tested for the removal of organic material followed by a density separation process. This approach was selected to afford comparability with existing sediment microplastic analyses. The selected reagents were: peroxide oxidation (60°C, 70°C), Fenton’s reagent, NaOH (1 M, 10 M) and KOH. The methods testing procedure was split into three phases: 1. Effect of reagents on test polymers; 2. Efficacy of reagents in reducing organic matter content in soil and sludge; and 3. Extractions including the incorporation of soil and sludge samples, including density separation. 7 reference polymers were used: HDPE, LDPE, PP, PS, PET, PC and PA-66, which account for >70% of global plastic demand. Degradation was observed for several of the reagents and selected polymers. NaOH treatments caused the most significant changes, including degradation of PET and PC. Small degradative changes occurred as a result of peroxide oxidation and KOH treatments. Fenton’s reagent and KOH treatments were not effective in sufficiently reducing organic material whilst peroxide oxidation and Fenton’s reagent removed the majority of organic material. Based on these results, Fenton’s reagent was identified as the optimum treatment and was further optimised. Phase 3 tested revealed high extraction efficiencies for this protocol. This is the first time a time- and cost-effective approach suitable for application in routine monitoring of complex environmental substrates whilst facilitating the collection of important particle information.

222 Mapping microplastics in sludge during a country-wide investigation of wastewater treatment and re-use D. Issler, NGI / Environmental Technology; L.B. Olsen, D. Issler, NGI; N. Berrojalbiz, NGI / Environmental Chemistry; S. Wongsoredjo, X. Shen, E. Teoman, KULeuven Key to understanding the fate of microplastic particles in fresh water are the changes they undergo as a result of various weathering processes, like biofilm growth, aggregation, UV exposure and physical stress. Some of these weathering changes they undergo as a result of various weathering processes, like biofilm growth, aggregation, UV exposure and physical stress. Some of these weathering processes that dominate (particulate) plastic fate, transport and interactions with biota until analytical techniques to measure native particulate plastics of small sizes and in trace concentrations have matured.

A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; R. Hurley, Norwegen Institute for water research; M. Olsen, C. Vogelsang, NIVA Norwegian Institute for Water Research Incorporation of anthropogenic particles into sludge has been highlighted as a major route for the transport of pollutants into the environment. Here we present the results of a country wide survey investigating the incorporation of microplastics into sludge from domestic wastewater treatment plants which operate different waste water and sludge treatment technologies. The main objective of this project was to characterize, map and compare results between different types of wastewater treatment plants. Samples were extracted using organic matter removal followed by a density separation procedure following. Plastics were identified in sludge samples from all treatment plants investigated. The overall average microplastic concentration was 6 077 particles kg\(^{-1}\) (d.w.) (1701 – 18 837) or 1 768 889 particles m\(^{-3}\) (470 270 – 3 394 274). Particles from sludge consisted of beads (37.6%), fragments (31.8%) fibres (28.9 %) and glitter (1.7 %). Most of the particles were clear in colour (41%). Ten percent of the overall particles extracted were tested using FT-IR. All particles (n= 60) were confirmed to be plastics. Polyethylene particles were the most common (30.5%) followed by polyethylene terephthalate (26.7%) and polypropylene (20.3%). 62% of plastics were extracted during the low density (1 g cm\(^{-3}\)) separation steps and 38% were extracted at high density (1.8 g cm\(^{-3}\)). Results between WWTPs were highly variable and there was no clear difference between average microplastic concentrations across the different treatment technologies. Based on these results, between WWTPs were highly variable and there was no clear difference between average microplastic concentrations across the different treatment technologies. Based on these results, the largest mass of microplastics in sludge was found in the samples. Comparing the masses of polymers in the effluent and in the raw sewage, a removal of 97 % of the polymers in the water treatment plant can be assumed. These results are consistent with the literature where removal rates between 98-99 % were described [6-7].
processes may cause changes in the density and shape of individual plastic particles, or aggregates. This can be a driving factor for the ultimate fate of microplastic, as it could cause floating microplastic to sink or be suspended below the water surface. However, the factors controlling the buoyancy or sinking velocity of different microplastic are not as well-known as they are for other particles/particles, like phytoplankton and sedimentary material. Herein we present the results of linking experiments on microplastic, covering different shapes (spheres, fibres, irregular), microplastics sizes in the environment and water properties, considering a range of ambient conditions (temperature, salinity and turbulence). The microplastic were compared before and after exposure to weathering processes in the lab and outdoors. The results obtained in this sinking experiment were compared to theoretical expectations, based on literature equations that describe the relationship between the drag coefficient and particle Reynolds number. A key advantage of this relationship is that it is independent on the type of plastic and properties of water, and would therefore apply to both freshwater and saline waters alike, as it would to all types of microplastics.

Air Pollution, Biomonitoring and Human Health (I)

224 Particulate matter in indoor academic environments: chemical composition, sources, infiltration from outdoor L. Tofail, CNR / Institute of Atmospheric Pollution Research; S. Canepari, Sapienza University of Rome / Chemistry; M. Catrambone, F. Marcocciaco, M. Giusto, CNR / Institute of Atmospheric Pollution Research; S. Pareti, CNR / institute of atmospheric pollution reasearch; T. Sargolini, CNR / Institute of Atmospheric Pollution Research; G. Pireddu, CNR Institute of Atmospheric Pollution Research / Institute of Atmospheric Pollution Research

We present the results of the first part of an experimental study carried out in an number of academic environments, ranging from small laboratories to very wide classrooms. The study was aimed to evaluate the mass concentration and the chemical composition of indoor atmospheric particulate matter (PM$_2.5$ and PM$_{1.0}$) and its relationship with a number of parameters. These include: concentration and chemical composition of outdoor particles, mixing properties of the lower outdoor atmosphere, volume and floor of the classroom, distance from the street, presence/absence of the students, season. Two type of sampling schedules were applied. The first one differentiates among working days, nights and week-ends during a 6-week winter period and a 4-week summer period (Special Observation Periods – SOPs). This schedule was planned to highlight the differences due to the presence of the students and teachers. The second one (Long-Term Sampling) consists in twelve 1-month PM$_{10}$ samplings carried out by using very low flow-rate samplers. It was envisaged to obtain a general picture of the effect of the above parameters during a whole calendar year. Both sampling schedules were applied to six indoor and four outdoor sites, all inside or around the same building. At each site and for both schedules the sampling were simultaneously carried out on Teflon, quartz and polycarbonate filters. Teflon filters were used for the determination of the collected mass (by gravimetry), of the elemental content (total content by energy dispersion X-ray fluorescence, bioavailable and residual fractions by inductively coupled plasma mass spectrometry), of anions and cations (by ion chromatography), of elemental and organic carbon (by thermo-optical analysis) and of the bioaerosol content (by propidium iodide staining and epifluorescence microscopy). A key advantage of this relationship is that it is independent on the type of plastic and properties of water, and would therefore apply to both freshwater and saline waters alike, as it would to all types of microplastics.

225 Source apportionment of major species and metals in PM$_{2.5}$ in urban sites under industrial influences in northern France F. Ledoux, University of Littoral Côte d'Opale / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492; A. Kfoury, University of Balamand / University of Littoral Côte d'Opale LISIC EA4491; G. Roussel, University of Littoral Côte d'Opale / Labomobile, Université des Sciences et de la Technologie de Lille / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492

PM$_{2.5}$ have been related to various adverse health effects, mainly due to their ability to penetrate deeply and to convey harmful chemical components inside the body. The North of France is one of the most densely populated area in Europe and is known as an industrialized region especially in the field of metallurgy, organic chemistry, and glassmaking. Furthermore, its strategic position in the heart of Europe means that this area is subject to major transportation activities by road and also by sea. In this context, the objective of this work was to acquire a better knowledge on the exposure level to major species and metals in PM$_{2.5}$ and on the identification of sources in urban regions influenced by particulate emissions from anthropogenic sources. Sampling was performed using Digitel® DA80 high volume samplers between November 2010 and April 2011 in three medium cities located in northern France, Dunkerque (Dk, coastal urban and industrial site), Boulogne-sur-Mer (BL, coastal and urban site) and Saint-Omer (SIO, inland urban and industrial site). PM$_{2.5}$ composition was analyzed for major elements, trace and transition metals. Sampling was performed for 7 days during winter, respectively. Species concentrations were examined according to different ways including temporal evolution, concentration and pollution roses.. The impact of such sources on major species and metal concentrations in PM$_{2.5}$ was then quantified using a weighted non-negative matrix factorization based receptor model that considers constraints on chemical profiles (CW-NMF). NO$_{2}$, SO$_{2}$, NH$_{3}$ and TC were found as the major contributors of PM$_{2.5}$ (between 95% and 99%). Factorial and seasonal differences were evidenced. Trace elements (Cr, Zn, Ni, As, Ag, Cd, Cu, Mn, Pb, V, Sn, Rh, Sr, Bi, Ba, Co, Sb and Ti) only correspond to 0.30% to 0.45% of the PM$_{2.5}$ mass according to the sites. The CW-NMF model identified 8 common source profiles at the 3 sites: secondary nitrates, residential and road traffic, secondary sulfates, fresh and aged sea-salts, heavy fuel oil combustion, non-exhaust traffic and crustal. In addition, 4 industrial source profiles were identified in Dk and one associated emissions and sintering stack of an integrated steelworks, electric steelmaking and glassmaking activities. Despite their low contribution to PM$_{2.5}$, such industrial sources were the main contributors of metals at the two sites.

226 Estimating the contribution of deposition in the total exposure to PAH's in order to derive safe deposition reference values J. Bierkens, VITO / Sustainable Health; L. Geerts, M. Van Holderbeke, VITO NV; K. De Brouwere, VITO NV / Health; A. Standaert, VITO; C. Cornelis, VITO / Environmental Risk and Health; T. Fierens, VITO

Partitioning of PAHs between the particulate and the gaseous phases strongly influences their fate and transport in the atmospheric and human exposure. Dry and wet deposition processes are major sources for PAHs in soil and crops. Our aim was to determine the proportion of the overall burden of environmental and dietary exposure to PAHs that is attributable to deposition in order to derive safe deposition reference values. To this end, the fate and human exposure was modelled using the MERLIN-Expo, a software tool that allows to model lifetime exposure, integrating exposure through multiple pathways. Model simulations were based on recent yearly average concentrations in air and particulate matter (PM$_{10}$) in Belgium. The conceptual model implemented, included inhalation, soil and dust ingestion as well as dietary exposure via the consumption of vegetables, meat and dairy products. Toddlers were chosen as the receptor as they are considered a vulnerable group. Dietary exposure to PAHs via crops was modelled using a plant uptake model representing leafy vegetables, fruits and grain, respectively. A cattle model taking its inputs from a grass and maize model was used to calculate concentrations in meat and dairy products. Concentrations in fish were modelled as an external fixed food source. The calculated concentrations for all these food categories were matched to Belgian consumption data in order to calculate dietary exposure. Estimation of the contribution of deposition in the overall exposure was done by comparing a baseline exposure scenario based on recent atmospheric measurement data with a scenario where dry and wet deposition fluxes were arbitrarily set to zero. Safe deposition reference values were derived by comparing the calculated overall exposure for the baseline scenario with the oral Tolerable Daily Intake (TDI). In case of exceedance, the deposition rates were iteratively adjusted until the calculated exposure equaled the TDI. Simulations were ran for 16 priority EPA - PAHs + benzo[a]fluoranthene. For only 4 PAHs sufficient measurement data are available in the EFSA database to perform a reality check. Of these 4 carcinogenic PAHs, only the calculated exposure to benzo(a)pyrene exceeded the TDI with a factor 4, implying that current deposition rates might be too high. More deposition measurement data for B(a)P are required to confirm these results. (The authors thank the Flemish Agency for Health and Care for their support)

227 A bioassay-directed analysis as a biomonitoring tool to assess the endocrine-disrupting air matrix contamination M. Debackere, S. Laborie, EPHE; E. Moreau-Guigon, EPHE; PSL / UMR METIS; F. Alliot, EPHE / UMR Metis; M. Bimbot, Univ. Paris-Sud / UMR ESE; A. Desportes, EPHE / UMR METIS; V. Huteau, Univ. Paris-Sud / UMR ESE; M. Chevreuil, EPHE / UMR METIS 7619; L. Ozio, University of Paris-Sud / UMR CNRS 8079

Air quality is currently assessed by monitoring a few pollutants involved in the inhalation of several dozen chemicals. To remain efficient, it is important to identify with any certainty the molecule responsible for a given biological effect, owing to human co-exposure to many bioactive micropolutants, which can also interact with each other. In this way, in vitro bioassays might be relevant biomonitoring tools to assess the air quality, as they integrate these “cocktail” effects. Furthermore, the pulmonary exposure to semi-volatiles endocrine-disrupting compounds (EDCs) may cause hormonal disturbances observed in humans, especially indoors where they spend 80% of their time. By using cellular bioassays, we have previously shown that bioactive EDCs tend to concentrate indoors, especially in the gaseous phase. The concomitant chemical analysis of a wide range
of EDCs led to the same conclusions, except in cold season during which the indoor gaseous phase concentrated fewer target EDCs than in summer along with presenting a higher endocrine-disrupting effect, especially estrogenic. In order to identify the bioactive compound families responsible for this endocrine-disrupting potential, a bioassay-directed analysis was developed and may represent an advanced biomonitoring tool for air quality. The gaseous phase was collected in a Parisian day (every during cold season (winter 2014) and in sufficient quantities (6 consecutive samplings of 15 days) to implement the entire fractionation process by semi-preparative liquid chromatography: split of the initial organic extract into three fractions, each fractionated into three subfractions. All these samples and the multiple controls were submitted to the chemical analysis (68 target EDCs) and the biological analysis (estrogenicity measured by transactivation cellular assay). After applying validated criteria for the selection of target EDCs in the environmental subfractions (concentration level, intrinsic estrogenicity, lipophilicity), major families found indoors (phthalates, synthetic musks, alkylphenols, parabens) stood out as playing a role in the estrogenicity of the gaseous phase, especially the lead compounds butylbenzylphthalate, galaxolide, butyl-paraben and nonylphenol. The data suggest however the involvement of non-studied EDCs in this biological effect. Our data confirm that bioassays represent suitable biomonitoring tools to assess air quality, whether they are associated with the chemical analysis or not.

The added value of using invertebrate species in ecotoxicology: new insights for environmental risk assessment (I)

230 Transgenerational effects of a parental exposure in the sentinel species Gammarus fossarum

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Since the 80s, the development of molecular biomarkers is an important component of ecotoxicology. Unfortunately, field studies that unequivocally link biomarker responses to fitness impacts and finally to population level are scarce (1). This is mainly due to the discordance in time scales between toxicological and ecological responses. In previous laboratory studies exploring the effects of high contamination levels of single molecules, a relationship has been established between genotoxic impacts in gametes of the sentinel species Gammarus fossarum, and impairment in embryo production. However, such a link was not observed after exposure to complex mixtures in the field at more environmentally realistic concentrations (2). Taking advantage of the availability of biomarkers measured in multiple scale in this species, from the molecular level (primary DNA damage, global DNA methylation) to physiological one (feeding rate, molting success, vitellogenesis) and life history traits (growth, fertility, embryonic survival), along with the possibility to conduct rearing culture in the lab (time to puberty about 4 months), the objective of this study was to assess whether biomarker responses revealed in adult gammarids exposed to a chemical stress could be predictive of the fitness of their progeny (i.e. transgenerational effects). For this, the consequences of an exposure in the lab of genitors to environmentally relevant concentrations of cadmium were evaluated in F1 and F2 individuals reared in uncontrolled conditions. In complement, a field exposure experiment through in situ caging of the adult F0 followed by the assessment of the subsequent effects in F1 and F2 progeny, currently in progress (References (1) Forbes VE, Calow P. Sibly RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994, (2) Lacaze E, Geford O, Goyet D, Bony S, Devaux A. 2011. Linking genotoxic responses in Gammarus fossarum germ cells with reproduction impairment, using the Comet assay. Environmental Research111:626-634

231 Species differences of bioaccumulation, biotransformation and synergistic effects of two fungicides in two aquatic invertebrates

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Numerous micropollutants are often detected concurrently in aquatic systems, but little is known about the mixture effects of micropollutants in aquatic organisms and the underlying mechanisms. Azole fungicides are known to act synergistically with other chemicals by inhibiting cytochrome P450 (CYP) catalyzed detoxification and thereby enhance the effect of already toxic substances in different organisms. Two widely used fungicide classes co-occur in surface water are strobilurin and azole fungicides. This study aimed to investigate the species’ sensitivity to both fungicide classes and to gain mechanistic insights on potential synergistic effects of azoles on strobilurin fungicides in non-target organisms. Therefore, we determined the toxicokinetics of a strobilurin fungicide azoxystrobin and an azole fungicide prochloraz in two aquatic invertebrate species Gammarus pulex and Hyalella azteca. Furthermore, we explored median lethal concentrations (LC50) of azoxystrobin in the presence and absence of prochloraz, the inhibition strength (IC50) of prochloraz, and its effect on the locomotory behavior of the two species. Bioaccumulation of azoxystrobin were similar in both species with bioaccumulation factors (BAFs) approximately 5 L kg⁻¹, while bioaccumulation of prochloraz was different in two species, with BAFs 57 and 110 L kg⁻¹ in G. pulex and H. azteca, respectively. Many biotransformation products were found for the fungicides in both species in a combination of enzyme activities, the fungicides were identified in H. azteca. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl β-methoxyacrylate group of azoxystrobin and imidazole ring of prochloraz. Prochloraz inhibited the CYP-catalyzed biotransformation of azoxystrobin in both species, leading to higher internal azoxystrobin concentrations and suggesting synergistic effects. The half maximal inhibition concentration of prochloraz IC50, μg/L was 0.1 and 0.02 μM in G. pulex.

228 The Modifying Effects of Ambient Air Pollution on Indoor Air Quality, Impacts on Human Health

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As energy efficient buildings and communities continue to grow, energy retrofits and new designs need to be made in concert with improvements in indoor air quality (IAQ). Although thermal renovations may decrease heat loss and reduce energy expenditures, improved indoor air quality (IAQ) can impact infiltration and air exchange rates, and magnify the effects and intensity of internal air pollutants. In this context, a pilot study was conducted to evaluate the human health risk associated with exposure to indoor air pollution in eight buildings ranging from green certified (i.e., LEED Platinum, Living Building) to historic archetypes. The buildings were located in the high conservation area, which is situated downwind of major industrial point sources. Indoor and ambient measurements of particulate matter (PM2.5, PM10), black carbon, ozone (O3), total volatile organic compounds (TVOC), carbon monoxide, carbon dioxide (CO2), relative humidity, and formaldehyde (HCHO) were collected on a seasonal basis. The heterogeneity in ventilation type along with the negative effects of deficiencies in heating and ventilation systems had on indoor air quality were distinct; however, the counterintuitive findings implied that green and naturally ventilated buildings underperform when compared to some of the conventional buildings within our study. The CO2 sensors used in most green buildings respond to the number of occupants within a space but does not consider ambient concentrations of criteria air pollutants (i.e., PM2.5, O3, NO2) before increasing outdoor air volume. Natural ventilation systems typically supply outdoor air to indoor spaces in the absence of mechanical filtration, and in turn compromise the health and well-being of building occupants. Additionally, green and high-performance buildings are equipped with state-of-the-art HVAC systems that work in tandem with occupancy sensors to optimize energy use when buildings are occupied and minimize energy use when buildings are vacant (overnight). To this end, with our limited sample size, our results may be generalized to other urban and residential areas. The results of this study are important for current and future building renovation projects in order to reduce indoor air pollutants and improve IAQ. In complement, a field exposure experiment through in situ caging of the adult F0 followed by the assessment of the subsequent effects in F1 and F2 progeny, currently in progress (References (1) Forbes VE, Calow P. Sibly RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994, (2) Lacaze E, Geford O, Goyet D, Bony S, Devaux A. 2011. Linking genotoxic responses in Gammarus fossarum germ cells with reproduction impairment, using the Comet assay. Environmental Research111:626-634

229 INNOVATIVE AND LOW-COST MONITORING TECHNIQUES FOR EVALUATING THE SPATIAL VARIABILITY OF PM COMPONENTS: VALIDATION AND FIELD APPLICATION

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A new very-low volume sampler has been developed with the purpose of allowing spatially-resolved determination of atmospheric particulate matter (PM) and of its chemical components. The low-cost, automatic and self-powered device assures long-term (1-2 months) collection of PM on membrane filters, suitable for subsequent chemical analyzes. The device is based on a new design of filter holder, which allows during a single study focused on the concentration of PM2.5 mass, ions, levoglucosan, polycyclic aromatic hydrocarbons (PAH) and elements. It showed very good performance in terms of repeatability of the samplings, which is the essential characteristic to build a reliable network. The samplers have been employed, for the first time, to evaluate the spatial variability of PM2.5 mass concentration and its main chemical components in the area of Terni, a urban/industrial hot-spot sited in an intramountain depression of Central Italy. Lichen transplants have been exposed at the same sites of the samplers in order to evaluate the potential of lichens as bioindicators for PM spatially resolved analyses. The meteorological conditions of Terni basin, which limit the dispersion and enhance the accumulation of atmospheric pollutants, are ideal to test and validate new experimental methods for the acquisition of spatially-resolved data.

SETAC Europe 28th Annual Meeting Abstract Book
and H. azteca, respectively. The LC50 of azoxystrobin alone were 157 and 200 µg L−1 in G. pulex and H. azteca, respectively. Prochloraz significantly decreased the LC50 of azoxystrobin in both species. Video-tracking of the locomotory behavior suggested that prochloraz induced hyperactivity in G. pulex, but not in H. azteca. Overall, results suggests H. azteca comprise more diverse biotransformation reactions and G. pulex tended to be more sensitive than H. azteca toward prochloraz effects.

232 Use of Gammarus sp. for toxicity testing. A case study with the growth regulator insecticide fenoxycarb,

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Gammarus sp. (Amphipoda) are widely distributed across European freshwater systems. In the present study, we evaluated the effect of a fenoxycarb exposure on Gammarus sp.. More specifically, i) we assessed the sensitivity of the embryo stage, ii) we identified embryogenesis’ sensitive period, iii) we evaluated the sensitivity of the reproductive period and iv) we compared the response to fenoxycarb exposure among three Gammarus species. Fenoxycarb is a growth regulator insecticide, analog of the insect juvenile hormone, used for pest management and for veterinary purpose. This study demonstrated that 5 and 50 µg L−1 fenoxycarb can alter embryonic development of G. fossarum. The gastrulation phase was particularly sensitive. Moreover, exposure to 5 and 50 µg L−1 fenoxycarb strongly altered the pre-copulatory behavior in G. fossarum and a 50 µg L−1 exposure prevented the production of viable embryos. These results highlighted the deleterious effects of the insect growth regulator fenoxycarb on gammarid embryogenesis and reproduction, which could have severe repercussions on population dynamics. The response to the toxic exposure was dependent on the study gammarid species which underlined the importance to consider species with broader phylogenetic representation to better assess insect growth regulator effects.

233 Adaptation of Gammarus pulex to agricultural insecticide contamination in streams

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Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce pesticide exposure and reduce the pattern of pesticide resistance. However, it is not known under which conditions adaptation occurs when only a low toxic pressure from pesticides is present. Here, we show that Gammarus pulex, a dominant macroinvertebrate species in many agricultural streams, acquires increased tolerance to pesticides when reexposed from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below considerate acute effects showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC50=218 µg L−1) compared with non-exposed populations (mean EC50=81 µg L−1). This tolerance of exposed populations increased from 2- to 4-fold with increasing distance to the next recovery site (0 to 10 km). We conclude that the development of tolerance for non-target species may occur at very low concentrations, much below those predicted to be safe by governmental risk assessment frameworks.

234 The use of antifouling biocides in a changing world: combined nanomaterial engineering and biological species

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The use of antifouling agents to prevent organisms’ adhesion onto surfaces continues to be used worldwide. While the European Union already authorized the use of DCOIT (4,5-Dichloro-2-octyl-2H-isothiazol-3-one) biocide, data on its toxicity to non-target organisms is still scarce. Given the advances in the encapsulation of biocides in smart-releasing systems, this work aims to access the impacts of a new antifouling approach, DCOIT encapsulated in silica nanocounters (SiNC@DCOIT), toward the non-target species Sarcophytion cf. glaucum, a coral that is also a model of the cnidarian-algae symbiosis found in some marine invertebrates. Elevated seawater temperatures, as predicted by global climate change scenarios, are described as a major cause of corals reef decline. Due to DCOIT photosynthesis inhibition properties, a joint effect of these two stressors (warmer seawater and DCOIT) may occur in the ocean. Toxicity assays were performed by exposing monocoral colonial fragments (n=5) for seven days, at two different temperatures (present day conditions—26°C—and forecasted scenario for 2100—30.5°C), to 50 µg DCOIT L−1 for free-DCOIT or SiNC@DCOIT and 196 µg SiNC L−1 (nanocounter control). A negative control was added for each temperature. Photosynthetic parameter (Fv/Fm) was measured using a Pulse Amplitude Modulated Fluorometer (PAM), with the behavioural endpoint (% polyps open) being scored and the biochemical parameters (both in animal and microalgae fractions) being determined by measuring the activity of catalase (CAT), glutathione-S-transferase (GST) and lipid peroxidation (LPO). Results revealed a decrease on Fv/Fm values at 30.5°C, when compared to 26 ºC (from 0.65 to 0.60), but only in corals exposed to free-DCOIT the temperature effect was significant throughout the days. By the end of the assay the polyps were mainly open at 26 ºC, whereas at 30.5 ºC they were closed. Regarding enzymatic activities, significant increase on the GST of both animal and microalgae fractions was found in 30.5 ºC groups. On the controls, the raise of 4.5 ºC in water temperature was responsible for a two or three-fold increase in algae and animal GST activity, respectively. The raise on temperature also induced an increment in CAT activity. Regarding LPO, high variability among samples was found. Overall, under thermal stress, the toxicity of DCOIT is enhanced and the negative impacts associated with the use of this biocide will likely be magnified in the warmest oceans.

235 Assessing interspecific variation in Imidacloprid toxicity in earthworms

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1 Centre for Ecology and Hydrology, Maclean Building, Benson Lane, Wallingford OX10 8BB, UK 2 School of Biosciences, University of Cardiff, Main Building, Museum Avenue, Cardiff CF10 3AT, UK Widespread interspecific variation is seen in the sensitivity of soil invertebrates to chemical pollutants (e.g. pesticides). Since chemical risk assessments are performed on the basis of tests in a small number of reference species there is a danger of significantly underestimating the effect a toxicant may have in the environment. In order to understand these differences a robust and scientifically based ecotoxicological framework for interspecies ecotoxicological extrapolation is needed. In this study a 30 fold difference in the EC50 reproductive values of imidacloprid was observed across 5 species of earthworms (Eisenia fetida, Lumbricus rubellus, Dendrobaena octaedra, Apporectodea caliginosa and Amynthas gracilis) with A. gracilis being the most sensitive and L. rubellus the least. The role of toxicokinetics in determining interspecific variations in sensitivity is interpreted by assessing the Accumulation, Distribution, Metabolism, and Excretion (ADME) of the chemical into the body and to the neurological tissues that are the common target using radiolabelled compounds and cold chemistry. The contribution of toxicodynamic traits to variations in sensitivity was assessed through genome analysis to identify 1) the number, nature and activity of key receptor genes present, and 2) molecular docking affinities as affected by the amino acid substitutions present in different species receptor homologues. Finally, to assess how these interactions affect the key biochemical and physiological parameters lead to overt toxicity, we use gene expression, biochemistry and life-cycle measurements. By combining these different approaches and identifying key traits, we seek to improve interspecies extrapolation, better predict species vulnerability, and thereby improved the basis for soil species protection during chemical registration.

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (I)

236 Multiple exposure to pesticides and other emerging pollutants – problems and solutions for healthy ecosystems and humans

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Industrial pollution is a severe threat to water resources around the world, particularly in the Global South factories release hazardous chemicals that impact our precious water resources - causing long term devastation to human health and the environment. Rivers supply vital resources, including drinking water, crop irrigation and food. They are an essential support system for industrial activity. In the past decades Greenpeace did several investigations on persistent chemicals like pesticides and industrial chemicals polluting waterbodies. Producing our food within an agricultural system highly dependent on synthetic-chemical pesticides doesn’t come without consequences. The impacts of industrial agriculture like Apple and fruit production are widespread, ranging from contaminated soil and water, to impacts on birds and other beneficial insects, as well as on farmers, their families and consumers. Starting in 2011 investigations in the
context of Greenpeace’s detox campaign have found a wide range of hazardous substances in the waste waters of textile production or in the effluent of communal wastewater treatment plants (WWTPs) from industrial zones in China, as well as in nearby rivers. Case Studies on per- and polyfluorinated chemicals show that PFAS (perfluorinated alkyl substances) are widespread compounds of environmental concern. Because of their well-recognized hazardous properties, long chain PFASs have been subject to increasing regulation. In 2015 Greenpeace conducted an expectation survey in 16 rivers, snow and lake water samples were taken at 10 remote high altitude sites showing that these persistent chemicals are present everywhere on the planet. In 2017 Greenpeace Italy carried out PFAS analysis in wastewater, analysis revealed PFASs presence in all tested samples of rivers and drinking water collected in schools and public fountain. It is not too late to act – but new rules and responsible policies are required. The use of pollution prevention control or wastewater treatment does not deal effectively with all hazardous substances, and only postpones the need for more effective measures. The problem has to be tackled at its source. The Detox campaign challenges top textile brands to work with their suppliers and eliminate PFAS and all other hazardous chemicals across their entire supply chain, and the entire life-cycle of their products. The growing concern about Europe’s massive pesticide use goes hand in hand with an increasing need to search for ecological solutions. To be effective, action needs to be based on knowledge, which requires transparency as a first step, the quantities of hazardous substances used and discharged to be reported and monitored, with full availability of data to the public. [1]


http://www.greenpeace.org/international/Global/international/publications/toxics/Water%202011/loudirty-laundry-12pages.pdf [1]


http://norman-network.com/?p=node/236 and NORMAN Digital Freezing Platform (http://norman-data.eu) as well as the US EPA CompTox Chemistry Dashboard (https://comptox.epa.gov/dashboard) can support NTS. Further, it will show how initiatives such as near “real time” monitoring of the River Rhine and retrospective screening via so-called “digital freezing” platforms have opened up new potential for exploring the dynamics and distribution even of as-yet-unknown chemicals. Collaborative European and international activities facilitate data exchange amongst analytical data scientists and enable quick, effective and reproducible provisional compound identification in digitally archived HR-MS data. This is leading to new ways of assessing and prioritizing the new generation of “emerging pollutants” in the environment, enabling a pro-active approach to environmental risk that is unthinkable only a few years ago. Note: This abstract does not reflect US EPA policy.

240 Toxicological profiling of water samples with in vitro bioassays and assessment using ecotoxicological data

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241 Chemical gene interactions for associating contaminants with biological effects
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Evaluating the potential human health and ecological risks associated with exposures to complex chemical mixtures in the environment is one of the main challenges of chemical safety assessment and environmental protection. There is a need for approaches capable of integrating chemical monitoring and biological effects. In recent years, the development of methods to detect and evaluate chemical interactions in the environment has been investigated. We present an approach that uses prior knowledge regarding the biological effects of individual contaminants to predict toxicity of mixtures and prioritize contaminants. More specifically, we use chemical-gene interactions networks to develop knowledge assembly models (KAMs) that are specific to the aquatic system of interest) based on chemical monitoring data and publically available chemical-gene interaction data. When only chemical data are available, KAMs allow for the development of site-specific hypotheses for follow-up biological effects testing. When transcriptions data are available, KAMs can be used with statistical approaches, such as reverse causal reasoning approaches to prioritize risk and contaminants. Two brief examples using chemical-gene interactions and KAMs will be presented. The first example used chemical monitoring data from the effluent of a local wastewater treatment plant (WWTP) to develop chemical-gene interaction networks. The networks were used to develop hypotheses about the biological effects of the effluent. To test the network predictions, targeted gene expression, using quantitative polymerase chain reaction, was measured from adult male and female fathead minnows that were exposed to the effluent. The second example used predicted gene expression data about chemical interactions to develop a KAM for detected chemicals at five locations near two WWTPs. Hepatic transcriptome data from fathead minnows exposed to site-water at each location were mapped to the assembly models to evaluate the likelihood of a chemical contributing to the observed biological responses using richness and concordance statistics. The use of chemical-gene interaction networks and KAMs have strong potential for associating chemical occurrence data to biological effects that, when integrated with adverse outcome pathway knowledge, can guide research and/or monitoring efforts related to the effects of contaminants in the environment. The contents of this abstract neither constitute nor necessarily represent official US EPA views and policies.

Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations

242 The triazole story: Clarification of sources, fate and footprint in the environment of the molecule 1,2,4-triazole
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1H-1,2,4-Triazole (124T) is a key structural component ofazole-fungicides, one of the world’s most widely used fungicide classes in agriculture. To develop protection industry taskforce (Triazole Risk Assessment Taskforce, TRAT) is jointly addressing scientific and regulatory topics, covering the environmental fate, metabolism, ecotoxicology, toxicology, and risk assessment of 124T. So far in the regulation of crop protection its origin was interpreted as a result of the breakdown of the parent azole-fungicides only. 124T is toxicologically classified as R63. According to the EU Regulation, Directive 1107/2009, it is a ‘relevant’ metabolite in groundwater and subject to a legal maximum concentration of 0.1 µg/l with respect to crop protection uses. Distinct restrictions on agricultural uses of azole-fungicides have been necessary to meet this hazard based limit value. In response to the large number and widespread use in the EU of registered azole products, regulatory authorities are asking for information about 124T’s potential leaching and actual concentrations in groundwater. The TRAT scientists discovered that 124T occurs ubiquitously in the environment, originating also from other anthropogenic sources than azole-fungicides, such as fertilizer additives (to avoid nitrate leaching) and commodity chemicals, and is also naturally formed. To investigate the different sources of 124T and elucidate the pathways of entry and distribution in the environment innovative approaches were needed. The TRAT scientists have therefore expanded their scientific scope into non-agricultural environments and residues in different matrices. The work is supported with a recent terrestrial field dissipation study using a 13C stable isotope labelled azole-fungicide to enable differentiation between the different sources, a forest soil study to assess the background abundance of 124T in non-agricultural soils, and several groundwater monitoring studies. This work has confirmed the wide range of sources of 124T and shown that it is currently not possible to distinguish between their contributions to measured environmental concentrations. Consequently, relying on azole-fungicides as the only source of 124T-concentrations could result in a systematic over-estimation of the environmental exposure risk from pesticide usage. An improved understanding of the sources of the molecule in the environment is a prerequisite for reliable and justified regulatory conclusions.

243 The triazole story: Assessment of the background abundance of 1H-1,2,4-triazole in selected German forest soils
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1H-1,2,4-triazole (124T) is an ubiquitous occurring small molecule which originates from different anthropogenic sources in the environment or from biotic or abiotic degradation of triazole-fungicides. In addition, 124T potentially originates from natural sources like soil microorganisms (Fungi, Actinomycetes). Information about the natural background abundance of 124T in forest top soils of German origin is of importance for the assessment of the entry paths and occurrence levels into the environment by crop protection measures. In a GLP terrestrial field study, duplicate forest top soil samples from ten different locations and different forest types (beech, spruce, pine, oak) in Germany were sampled in 2012/2013 for analytical investigation of the 124T background. For this reason, remote areas without close contacts to agricultural areas were selected. In addition, at two of these ten sites the development of the 124T residue background level was investigated over the period of one year. The background abundance of 124T in the samples ranged from < 1.0 to 1.9 µg/kg in oak forest top soils, from 1.0 to 2.1 µg/kg in pine forest top soils, and from < 1.0 to 1.2 µg/kg in spruce forest top soils. In the selected beech forest top soils the background abundance of 124T was below 1.0 µg/kg. The background abundance of 124T in beech and spruce top soil samples taken from April 2012 to February 2013 showed fluctuations over time. These variations could not be associated to seasonal changes. Single values ranged from < 1.0 to 1.8 µg/kg in the beech top soil samples and from < 1.0 to 2.1 µg/kg in the spruce top soil samples. Overall, a background abundance of 124T could be selected for all forest top soil samples. Subsamples of German forests where anthropogenic 124T sources (e.g. fertilizer additives, metabolites of triazole-fungicides, breakdown product of commodity chemicals) could be excluded. This indicates that the measured 124T residues originate from natural sources in the environment.
Challenges of a groundwater monitoring study design for a substance with multiple sources: determining risk for groundwater from 1,2,4-Triazole formed from fungicides used in arable crops in Germany

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1H-1,2,4-Triazole (124T) is a widely occurring molecule with a number of anthropogenic sources, but also biogenic sources, all of which may result in the presence of the molecule in groundwater. The regulatory framework under which potential risks to environment and health are assessed, including applicable trigger concentrations, depends on the source. As a metabolite of triazole fungicides used in agriculture, 124T is regulated under EU Regulation 1107/2009 and subject to a regulatory trigger concentration of 0.1 µg/L in groundwater. At the same time, 124T is also used in agriculture as a nitrification inhibitor added to mineral fertiliser or slurry, making this a potential additional source contributing to overall soil load. The risk to groundwater from this use is however assessed under other regulations. To address regulatory concerns about the leaching risk for 124T from combinations of triazole fungicides used in agricultural practise, the industry group TDMG has conducted groundwater monitoring studies in Germany. As the aim was to evaluate the risk from triazole fungicides only, the challenge was to design studies to sample groundwater in areas with intensive triazole fungicide usage, where applications of 124T-containing fertiliser and other potential sources could be reasonably ruled out. Existing wells from authorities’ or water producer’s monitoring networks were sampled in the studies, thus capturing a range of scenarios for leaching risk in real-world agricultural practice. To rule out other anthropogenic sources of 124T, for each potential monitoring well a stepwise screening approach was applied to ensure suitability, with in-depth farmer interviews to document relevant product applications and rule out use of 124T-containing fertilizer in the upstream infiltration area. In total 211 groundwater samples from 31 wells in different regions of Germany were analysed. All samples were < 0.1 µg/L, with 14 samples between 0.05 (=LOQ) and 0.08 µg/L. The results show that even with intensive use of triazole fungicides, the concentrations of 124T in shallow groundwater downstream from treated fields did not exceed the regulatory trigger of 0.1 µg/L. The presented approach is considered to be effective to obtain a realistic picture of groundwater exposure to 124T from triazole fungicides in agricultural practise. Ruling out other sources is challenging, but possible with site screening and engagement with the farmers.

245 Leaching of 1,2,4-triazole through agricultural fields in Denmark

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The compound 1,2,4-triazole is a degradation product of many azole fungicides and growth regulators used in agriculture. Leaching of 1,2,4-triazole from agricultural fields has been evaluated in Denmark in the Danish Pesticide Leaching Assessment Programme (PLAP; www.pesticidvarsling.dk), which comprise five agricultural fields with different use of 1,2,4-triazole fungicides. The project started in 2014 and is still ongoing. 1,2,4-triazole is monitored in groundwater and in 1 m depth in water collected from tile drains and suction cups. The known applied sources of 1,2,4-triazole in PLAP from 2014 to 2015 are the fungicides tebuconazole, epoxiconazole and prothioconazole, where the latter according to the EFSA conclusion only forms minor amounts of 1,2,4-triazole. The results show that even with intensive use of triazole fungicides, the concentrations could result in a systematic overestimation of the environmental exposure risk from pesticide usage.

246 The triazole story: Differentiation between different 1,2,4-Triazole sources using a 13C stable isotope labelled azole-fungicide

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1H-1,2,4-triazole (124T) is a small and ubiquitously occurring molecule which originates from different anthropogenic sources (e.g. azole-fungicides, fertilizer additives, pharmaceuticals) but is also naturally formed. The environmental degradation pathway and footprint of 124T is complex, partly still unknown, and very difficult to correlate to individual sources. 124T is toxicologically classified as R63, so according to the EU Regulation, Directive 1107/2009, it is a ‘relevant’ metabolite in groundwater. To investigate the different sources of 124T and elucidate the pathways of entry and distribution in the environment innovative approaches are needed. A GLP terrestrial field dissipation study investigated the dynamic of 124T produced from Tebuconazole (TBZ) in the field and aimed to gain Deg/T50 data for 124T and TBZ while differentiating between different 124T sources. In the study 13C labelled TBZ (13C-TBZ) was applied to bare soils in six different locations across Europe (Spain, Italy, UK, Germany, Belgium, and Denmark). The use of non-labelled triazole fungicides or N-stabilized fertilizers could be excluded for all sites since 2013. 13C labelling allowed for the differentiation between 124T from TBZ and from other sources. Soil samples were collected 0 to 360 days after application, in triplicates and in additional control plots. The soil samples were analysed for residues of 13C-TBZ, unlabelled TBZ (12C-TBZ), 13C labelled 124T (13C-124T), and unlabelled 124T (12C-124T). Residues of 13C-TBZ remained in the top-soil segments. There were no detect of 12C-TBZ in any of the investigated samples. 13C-124T as the degradation product of 13C-TBZ could be detected in all six trial sites in varying concentrations. Of special note, 12C-124T was detected in four of the six trials, even though the use of triazole fungicides on the trial plots could be excluded for a minimum of three years before the application. At one trial site, residues of 12C-124T were detected down to a depth of 100 cm in all plots with a maximum concentration of 117.6 µg/l. The data collected in this study confirm that in many cases the origin of 124T findings is not the use of azole fungicides, but other sources. Consequently, relying on azole-fungicicides as the only source of 124T-concentrations could result in a systematic over-estimation of the environmental exposure risk from pesticide usage.

247 Overlooked sources of trfluorooacetate in the water cycle - consequences for drinking water supply and regulatory measures

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Relevant amounts of trifluoroacetic acid (TFAA) are formed in the atmosphere by photochemical transformation of several refrigerants and subsequently introduced into the aquatic environment by wet deposition. TFAA occurs as trifluoroacetate (TFA) in the aquatic environment and is considered to be persistent and mobile. Both the acid and its potassium salt are manufactured and/or imported in large amounts in the European Union. Furthermore, TFA is a byproduct of the biodegradation product of several pesticides. During a screening of surface waters in south-West Germany, high concentrations of TFA (up to 140 µg/L in a tributary of the River Rhine) were detected. As a consequence, concentrations of TFA at adjacent bank filtration sites and tap waters were also substantially elevated. The here presented study aims on source identification as well as on the assessment of treatment options (ozonation, chlorination, activated carbon filtration) for contaminated raw waters. Ozonation of model substances and wastewater samples was applied to reveal the TFA-forming potential of individual compounds and the presence of not yet identified TFA-precursors in waters bodies in general. Discharge of industrial wastewater was identified as the source of elevated concentrations of TFA in the Rhine tributary. Extended monitoring demonstrated that this contribution is only a fraction of the drinking water supply along the lower River Rhine. Ozonation, activated carbon filtration, and chlorination do not allow for considerable removal of TFA. Monitoring of wastewater treatment plants (WWTP) demonstrated that WWTP also emit TFA. One WWTP showed substantial formation of TFA and ozonation of WWTP-outflows led to increasing concentrations. Tests on the formation of TFA by ozonation of the selected potential precursors demonstrated highly compound-specific TFA-yields between insignificant and ~40%. Sources and pathways of TFA may still stay hidden. As contaminated water resources cannot be efficiently treated by technical options typically applied in water utilities, this topic needs to be addressed for sustainable raw water management. Small molecules such as TFA may originate from different sources and their individual contributions may be subject of temporal and spatial variability. This must be taken into account with regard to risk assessment as well as for the regulation and authorization of chemicals.

Persistence & Biodegradation Assessment

248 Why biodegradable chemicals persist in the environment? A look at bioavailability

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The biodegradability of a given chemical in the in the environment cannot be assessed properly without considering the chemical’s bioavailability to the degrading microbial populations. This is especially applicable to hydrophobic organic chemicals (HOCs), like polycyclic aromatic hydrocarbons (PAHs). With the aim of providing pathways for implementation into regulatory contexts, this
overview contribution will examine the range of techniques and experimental models suitable for the assessment of HOCs biodegradability taking into account state-of-the-art bioavailability science (Environ. Sci. Technol. 49:10255-10264, 2015). During recent years, we have applied these techniques to study the microbial interconnections with bioavailability processes, involving pollutant phase exchange, microbial mobilization and cell attachment to interfaces. We can consider two groups of techniques; 1) Broadly applied methods to estimate the bioavailable contaminants using Fenton or passive sampling, methods also subject of standardization and 2) specific methods suitable to deeply characterize phase exchange with liquid mixtures and 14C-labelled chemicals. Examples and applications of these approaches will be summarized. They include desorption extraction (Environ. Sci. Technol. 45:3019-3026, 2011; Environ. Sci. Technol. 48:10669-10677, 2014), passive sampling and dosing methods (Environ. Toxicol. Chem. 27:1526-1532, 2008; Environ. Pollut. 184:435-442, 2014; Environ. Pollut. 205:378-384, 2015), constant NAPL/water interfacial area method (Environ. Sci. Technol. 45:1074-1081, 2011; Environ. Sci. Technol. 51:11935–11942, 2017), and radiorepistoriometry and dual 14CResidue analysis (Environ. Pollut. 159:3692-3699, 2011). In spite of these advancements, significant gaps of knowledge exist between bioavailability and biodegradation sciences. Still today, it is difficult to predict bioavailability of HOCs, for example, solely on the basis of basic parameters such as organic matter, black carbon or clay contents of a given soil or sediment, and the physiochemical constants of the chemicals (such as solubility in water, octanol-water or organic-carbon based distribution coefficients). This limitation even remains with improved assessments through determinations of chemical activity and bioaccessibility. This uncertainty not only applies to biodegradability in natural environments, but also to engineered remediation systems.

249 Strategy for ready biodegradability evaluation of poorly water-soluble organic compounds in aqueous media


The assessment of the environmental impacts of an environmental substance is based on ready biodegradability tests, demonstrating a rapid biodegradation in most environmental media. However, when these tests are applied to poorly water-soluble substances, difficulties are encountered, often related to their limited bioavailability towards the microorganisms inducing increased variability that we have studied. An innovative strategy has therefore been established in order to improve assay design and biodegradation understanding of how plant performances are affected by operational and environmental parameters, such as temperature fluctuations (e.g. daily and seasonal). Currently, environmental exposure assessment uses Arthemius-based models to estimate biotransformation rates at different temperatures, despite they neglect potential compositional and functional variation of the microbial community. This work aims to evaluate the validity of such models, by exploring the effect of short-term temperature variation on micro pollutant biotransformation in an aerobic sludge community. Laboratory batch reactors were seeded with activated sludge from a Swiss full-scale treatment plant and the biotransformation of 93 target micropollutants (6mg/L) was monitored over time at five different temperatures (4-40°C range). The experimental kinetic parameters were compared to model predictions. The microbial population was also characterised by high-throughput sequencing to reveal community composition and activity during the biotransformations. Positive correlation of biotransformation rate constants with temperature was found in the 4-20°C range. At higher temperatures, the biotransformation potential decreased or reached a plateau for the majority of the compounds, and just a limited group showed a steady increase. Despite basic linear model equation predict rate constants above 20°C, despite major risk assessment guidelines recommend Arthenius model predictions in the 0-30°C range. The microbial community also showed significant shift in both composition and activity at higher temperatures, in agreement with the observed decrease in biotransformation potential. Contrarily, for compounds showing an Arthenius-behaviour over the 4-40°C range, the biotransformation processes may be linked to basic living cell functions as being sensitive to temperature fluctuations. Our study highlights limitations in the applicability of Arthenius-based models for the estimation of chemicals fate in biological systems, and the need to re-examine model parameters to assure more accurate predictions for potential chemical exposure in events of temperature fluctuations.

251 Findings from an international ring test for an improved marine biodegradation screening test


A series of standardised biodegradation screening tests (BSTs; e.g. OECD 301, 306) have been developed to measure the relative biodegradability of chemicals. Recently, regulatory emphasis has shifted from measuring biodegradation towards prioritisations on chemical persistence. In their current guise, BSTs are ineffective as screens for persistence. They are prone to high levels of variation and produce a large number of fails, many of which can be considered false negatives, whereby a chemical fails a test not because of its recalcitrance, but rather because the test itself has failed. An ECETOC-funded workshop to discuss improvements to marine biodegradation testing was delivered in 2015. During this workshop, methodological improvements to BSTs were discussed, in addition to clarifying guidance on testing and interpretation of results obtained from marine BSTs. Methodologically: (i) increasing bacterial cell concentrations to better represent the bacterial diversity inherent in the sampled environments; and (ii) increasing test durations to investigate extended lag phases observed in marine assessments, were recommended to be validated in a multi-institutional ring test. This presentation will report the findings from an international ring test of an improved marine BST, whereby an improved marine BST comprising inocula concentrated by tangential flow filtration, a modified marine BST comprising seawater and a standard OECD 306 closed bottle test were compared across 13 laboratories in the UK, Norway, Germany, Italy, Canada, USA and Japan. Five test chemicals including a positive reference compound (sodium benzoate), a negative reference compound (pentachlorophenol) and three compounds with variable reported degradation (4-nitrophenol, triethanolamine and hydrolysed polycrylamide), were used to provide a range of biodegradation potentials by which to validate the new method. Biodegradation data for the five chemicals, in the three test systems used, across the 13 participating laboratories will be presented. The need for clearer guidance on biodegradation testing and interpretation will be discussed, with particular reference to test variability and extended lag phases frequently encountered in marine biodegradation assessments. The role which microbial communities play in chemical biodegradation and the extent to which microbial community analysis can explain intra- and inter-laboratory variation in biodegradation test outcome will also be discussed.

252 Relevance of photolysis for the fate of pentamidin phenyl ether in deeper water layers - results of a scale-up approach according to OECD TG 309


Research & Innovation / Life Sciences Direction

Poster spotlight: TU267, TU268, TU269

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Integrating life cycle approaches towards a sustainable circular economy (I)

How can we measure a sustainable circular economy? Unveiling current indicators for the life cycle of products

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Currently, EU policy on circular economy (CE) aims to decrease environmental damage as well as secure the future supply of resources to support economic growth. Even though the implementation of new strategies might cause burden shifting, it is mostly assumed that an increased circularity of resources results in environmental benefits. At the same time, indicators suggested to assess CE progress often fail to provide an assessment of both CE goals and strategies from a sustainability perspective. A life cycle perspective provides a point of departure to address CE strategies, as the stages involved in the circulation of materials are clearly illustrated. Nevertheless, which indicators to assess is still to be defined to support the implementation of CE at any stage of the supply chain. This contribution aims to identify the type of indicators suggested to measure the progress towards a CE at a product level and to evaluate these in relation to the overarching goals and the implementation strategies of CE. To this end, we first define the main CE goals and implementation strategies identified in recent literature and translate these into measurable flows by creating a system model that accounts for each step in the product life cycle. Finally, we review the literature on CE indicators and classify them into CE goals and strategies, life cycle stages and flows addressed, and measurement units (i.e. economic, mass, energy or environmental impact). This contribution provides a consistent framework to compare and assess CE performance indicators at a product level. It also aims to develop a hierarchical decision analysis for ranking CE indicators. Through a structural assessment of currently suggested CE performance indicators, we can define gaps and needs in the monitoring process of CE to ensure that progress contributes to the overarching goals of CE and in turn capture trade-offs between implementation strategies.

Making sense of circularity indicators with Multi Criteria Decision Analysis

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The focus of this study is on packaging, i.e. a sector with high priority for circular economy (CE) implementation, by exploring a situation where a company intends to compare the circularity performances of different products in order to identify which is the best option from a CE perspective. We considered six different packaging alternatives for a beverage in different contexts and calculated the following indicators to assess product-level circularity: i) the Material Reutilization Score (MRS) included in the Cradle to Cradle® certification program; ii) the Material Circularity Indicator (MCI) developed by the Ellen Mac Arthur Foundation and Granta and iii) the most relevant impact categories according to the Product Environmental Footprint Category Rules for beer product category, i.e. climate change (CC), acidification (Ac), and marine eutrophication (ME). The Multi Criteria Decision Analysis (MCDA) methodology provides an integration approach to aggregate indicators representing performance of the product system with respect to various aspects such as material recyclability, recycled content and eco-efficiency. We argue that ranking the alternatives based on such approach will ease the identification of the best packaging alternative from a CE perspective. The MCDA is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDA method TOPIS (Technique for Order of Preference by Similarity to Ideal Solution) is used for ranking the six alternatives. The results of the stand-alone application of the two types of indicator sets, i.e. those focusing only on circularity (MRS and MCI) and on life cycle assessment (CC, Ac, ME) are different. The ranking of the packaging is the same within the life cycle assessment indicators, but differs when MCI and MRS are considered. The implementation of the MCDA with different weighting sets shows that two alternatives are dominating i.e. have higher scores for all the indicators. These two alternatives are ranked in the first two positions in all the weighting schemes and hence the ranking is considered as stable. The use of MCDA in combination with several product-circularity indicators is thus recommended to support companies in identifying the best alternative from a CE perspective.

Consistent allocation using archetypes of LCA Goal and Scope definitions

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Defining a suitable allocation procedure is always a challenge in the modelling of LCA studies. This is even more so for products that are both manufactured from recovered materials and that could be used in multiple life cycles due to efficient recycling. PE International recommend how to apply allocation for the production and recycling of metals [1]. However, by recommending both partitioning and substitution for establishing the data for an attributional LCA, several inconsistencies are introduced. It becomes unclear to what research question LCA results respond if different modelling approaches are combined in a single LCA study. We developed archetypes of LCA Goal and Scope definitions – in the form of research questions – that aid in identifying a suitable and consistent allocation procedure. In order to identify the LCA study type, the potential life cycle stages and the products of the LCA scope need to be clearly defined: the topic of the LCA, the perspective, the reason to conduct the study, and potential additional functions of the product system that are taken into consideration. We present a framework that shows how the allocation procedure is dependent on the different LCA approaches that are defined in the goal and scope of the LCA. Based on this framework, building blocks are derived that are used to formulate research questions. These research questions represent archetypes of goal and scope definitions. The presented framework shows that there is a relevant difference between system expansion and substitution, and that we must differentiate between process-oriented and product-oriented LCAs, which is not common practice. Furthermore, we show that all types of LCA approaches can be used to support decision-making, which is often only ascribed to consequential LCAs. It is concluded that it is not the topic but the research question of the LCA study that determines the most suitable allocation procedure. One LCA topic (e.g. 1 kg of recycled aluminium) can already be used for at least 13 different research questions. “What is the impact of 1 kg of recycled aluminium?” is not detailed enough to identify an LCA modelling approach. This paper shows the level of detail that is required to enable this. The importance of a research question is not always visible. The production phase of the laptop is modified to reflect a closed loop for recovered materials. For this reason, only a limited number of materials are taken into account. The recycling scenario assumes the optimistic case that all laptops are collected. The pre-processing of the laptop is modelled using a manual depollution step followed by mechanical treatment. The end-processing is modelled assuming recycling in an average European electro-furnace, aluminium production site and copper smelter and precious metal refining. In the third scenario, a second life of 3 years is assumed for the repaired laptop. The main environmental impact of the repair activity is the replacement of components. It is assumed the laptop requires a new hard disk drive and a new battery. No additional transport is assumed for self-repair by consumers. In order to increase the number of successful repairs and reduce the required time, current European policy aims to improve the reparability of products. The potential environmental benefits of repair after repair is investigated by considering a baseline, recycling and reuse scenario. The baseline scenario is considered to be the worst case because it does not consider any recycling or reuse and it assumes all waste is incinerated. A professional use of 3 years is assumed with an annual electricity usage of 76 kWh from the average European grid. For disposal, a specific incineration dataset was calculated based on the assessed laptop composition using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. At the end of its functional life, the laptop is modified to reflect a closed loop for recovered materials. For this reason, only a limited number of materials are taken into account. The recycling scenario assumes the optimistic case that all laptops are collected. The pre-processing of the laptop is modelled assuming a manual depollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production site and copper smelter and precious metal refining. In the third scenario, a second life of 3 years is assumed for the repaired laptop. The main environmental impact of the repair activity is the replacement of components. It is assumed the laptop requires a new hard disk drive and a new battery. No additional transport is assumed for self-repair. At end of life the laptop is assumed to be recycled, as described above. The case study presented in this paper indicates that repair of laptop’s should be considered before discarding for material recycling. The potential benefits of material recycling for high-end or closed loop applications remain limited. If the extended life is at least 2 years, the number of components to be replaced considered in this case study does not impact the decision making. The results also show that increased energy efficiency of new products has a limited impact on the overall results.

Building - Rooftop Symbiosis at the next level. Improving urban agriculture through circular economy strategies

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Cities food supply has become an emerging problem with consequences like greenhouse gas emissions or land occupation. In this direction, new ways of producing food within the limits of cities have arisen as potential solutions. Integrated Rooftop Greenhouses (i-RTG) have the potential of a conventional greenhouse for producing vegetables, but they are located at the top of a building,
where they can benefit from different residual flows that were previously being wasted. In ICTA-ICP building (4 floors), in the UAB campus (Bellaterra, Barcelona), a rainwater harvesting system stores rainwater on an underground tank, from which water is pumped to the rooftop to irrigate the crops with a hydroponic automated system. In the third floor, high CO2 concentrations (up to 820ppm) and more stabilized temperatures (between 15 and 22°C) are reached. The transport of the air to the rooftop could benefit crop production by performing a CO2 enrichment and providing more suitable temperatures to the plants. In this aspect, an open chamber made of steel and LDPE will be used to compare its environmental performance and production with a control crop, using life cycle tools. In this direction, previous LCA studies have stated that the fertilizers are one of the items that exerts the greatest impacts in iRTG systems. Hence, different nutrient use strategies can be optimized. In this sense, different literature express that half of the currently economic phosphate resources will have been used up in 50 to 100 years. To optimize P cycle, struvite has been defined as a potential source of this nutrient. With a circular economy perspective, wastewater treatment plant precipitated struvite will be used as the P source for crops in the i-RTG in two different ways: mixing struvite in the nutrient solution and by adding struvite in perlite sacks (hydroponic substrate). The goal of this contribution is thus to evaluate the CO2 and P cycles in an i-RTG through experimental and environmental studies by considering circular economy strategies. With these enhancements, urban agriculture will cut its environmental impacts, making it a more sustainable source of food for cities.

259 Chemical recycling of plastic packaging waste - A life cycle perspective on PET recycling

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Plastic packaging waste is one of the priority areas inside the European action plan for the transition to a circular economy. To establish a circular economy, a potential large-scale avenue is chemical recycling of plastic packaging waste. However, preliminary assessments of chemical recycling technologies rate them inferior compared to mechanical recycling not only from an economic but also from an environmental point of view. Based on these results, we develop a method based on life cycle assessment to evaluate the environmental performance of chemical recycling to produce chemicals. The method calculates the maximal environmental impact reduction for chemical recycling technologies for future industry setups. To calculate the maximal environmental reduction, a general model of the life cycle of plastic packaging waste is developed from cradle-to-grave. The results are benchmarked against both mechanical recycling and energy recovery for the environmental impact categories climate change and fossil resource depletion. The basis of the calculations are four key system parameters: (i) the efficiency of the waste treatment technology and the environmental impacts of (ii) production of secondary materials, (iii) the waste treatment technology and (iv) the target chemical produced by chemical recycling. The presented method is used to evaluate chemical recycling technologies for polyethylene terephthalate (PET). In this case study, we show the need to produce high value-added chemicals from chemical recycling technologies to possibly achieve an environmental benefit compared to mechanical recycling. To improve on mechanical recycling, chemical recycling needs to yield a chemical that is currently produced with an impact on climate change or fossil resource depletion exceeding 2.54 kg CO2 eq. or 1.58 oil-eq, per kg, respectively. To the best of the authors’ knowledge, no chemical in patents or literature meets both of these threshold values. In contrast, chemical recycling is beneficial compared to energy recovery in all studied cases. The presented method enables the easy and early-stage assessment of the maximal environmental reduction of chemical recycling. The case study shows that chemical recycling should target PET waste that is currently used for energy recovery or needs to transform waste from mechanical recycling to high value-added chemicals.

Informed substitution of hazardous chemicals for circular economy: science and practice

260 Substitution of PFOS under the Stockholm Convention


In 2009 PFOS, its salts and PFOSF were added to the UNEP Stockholm Convention aiming at protecting human health and the environment from POPs. However, the addition contained twenty exempted uses, for which PFOS could still be produced and used. These exemptions were accepted, accompanied by a delay in the implementation of new regulations in order to facilitate a total phase out. Besides the evaluation, the Convention provides Guidance of alternatives to PFOS, which is regularly updated and meant to facilitate the Parties to the Convention in phasing out PFOS. The evaluation was carried out in 2014 under the POPs Review Committee. In 2016 the previous Guidance on alternatives was updated, followed by endorsement in 2017. The update focused on all known applications of PFOS, including the twenty exemptions. However, priority was given to the open applications in two pesticide uses, namely insect baits for control of leaf-cutting ants from Atta spp. and Acromyrmex spp. and insecticides for control of red imported fire ants and termites. Data on these uses will be reviewed at the next update in 2022. The substitution will focus on the further need of PFOS and the specific uses in various Parties under the convention and possible alternatives among which chemical and non-chemical ones. The recommendations of the POPs Review Committee led to the decision to request the Parties using PFOS for ant baits to deliver data on production and use and monitoring data on emissions at the points of use. In concluded that in phasing out a substance, it is necessary to understand the functional characteristics of the substance in that specific application and to follow a case by case approach. This enables to find alternatives and to define the proper measures. A multidisciplinary approach is indispensable in this phase-out process.

261 Experiences of “Substitution in Practice”

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Within the research project SUPFES (Substitution of per Fluorinated compounds to Eliminate diffuse Sources) research on the substitution of hazardous chemicals in consumer products is focused on identifying feasible solutions with better sustainability performance. Such substitution model, suggesting evaluation for both technical as well as environmental and health performance, requires an interdisciplinary approach to create and/or identify feasible alternative solutions. SUPFES SIP model includes (1) characterisation of PFAS in use for the evaluation and guidance of selected consumer products 2) initial alternative selection based on matching function criteria and toxicity and exposure assessment and 3) final selection of alternatives undergoing full environmental impact and technical performance assessment for specific scenarios. The SUPFES project has demonstrated an iterative model for practical substitution where in addition to evaluating the environmental and health performance of alternatives, the technical and economical performance are also included. It is clear that distinct substitution strategies will be required for PFASs in different textile products because of the range of performance requirements. Evaluating functionality of the different products revealed that it is critical to have a chemical (alternative) product that has the required functionality, but also to measure function in new ways matching the actual requirements. Hazard assessment for chemical alternatives is a key challenge in substitution. Very toxic compounds may be present in an alternative chemical formulation, but the levels are either really low or absent in high quality products. Furthermore, there is clear lack of key information on what is in chemical products and what is released from these products (e.g. do we have polymer degradation leading to toxic degradation products or not). From the environmental and health assessments, the specific chemical substitution, life cycle representation and evaluation and guidance criteria and toxicity and exposure assessment are needed to make a trade of between protecting the user of the garment in certain working environments and high environmental impact. In addition, different environmental impact categories might give contradictory decision support.

262 Implementing a life cycle perspective in chemical alternatives assessment - the case of per- an polyfluoroalkyl substances in textile applications

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Informed chemical substitution is about eliminating chemicals that give rise to unacceptable (eco)toxicological risks, while avoiding problem shifting within a product’s or chemical’s life cycle, or between types of impacts. For this reason, the life cycle perspective becomes crucial. Chemical alternatives assessment (CAA) performance has been improved in recent years, and life cycle assessment (LCA) and life cycle thinking are part of the more comprehensive CAA methods available. However, more detailed guidance is lacking and few practical examples have been published. A substitution case of current relevance is the substitution of per- and polyfluoroalkyl substances (PFAS) from durable water repellent (DWR) textile applications. Alternatives are sought which offer sustained technical performance but an improved environmental and health profile compared to the hazardous PFAS. To support an informed substitution of hazardous PFAS, and complement our previous hazard assessment, we have conducted an LCA to compare environmental and human health impacts across DWR alternatives on a
functional basis. Based on this case we were also able to further elaborate on the inclusion of the life cycle perspective in a CAA framework by identifying both possibilities and challenges. We conclude that the inclusion of a life cycle perspective in CAA is crucial for an informed and sustainable substitution, as lack of life cycle thinking can lead to problem shifting. We show that LCA, with its focus on function, is a tool that can identify such problem shifting as well as the key chemical properties to be considered for their underlying toxicological effects in such cases. However, this approach is not limited to the specific substances such as the PFASs if they are outside the domain of the LCIA model. In the case under study here we conclude that the DWR should be selected with three main considerations: (i) the intrinsic hazard properties of the chemistry, selecting the DWR associated with the lowest hazard but, (ii) providing the functionality as needed and, (iii) giving the garment the longest life length.

263 How much function do we need in textiles? Strategies for replacing PFASs based on end-user requirements

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Current approaches to substitute harmful chemicals could benefit from a broader perspective when it comes to the functionality they provide in consumer products. Following the concept of “functional substitution”, this study presents an evaluation of material properties of new durable water repellents (DWR) for textiles focusing on end-user requirements. Since the phase out of side-chain fluorinated polymers (SFPs) based on long perfluoroalkyl moieties was associated with the release of persistent, biaccumulative and toxic perfluoroalkyl acids (PFAAs), a variety of new DWRs have been developed including biodegradable materials that are based on renewable resources and have lower intrinsic hazard properties to provide substances and oleophobic fibre modifications SFPs based on long perfluoroalkyl chains were historically used on all kinds of different textiles applications. It is so far unclear if alternative DWRs can follow this “one solution will solve all” approach. By segmenting the textile sectors in terms of liquid repellency, this study sets out to outline the different requirements in case studies for functional outdoor clothing and occupational medical apparel. For functional outdoor clothing, a “bottom-up” strategy was chosen by using a survey to assess the consumers’ needs and expectations. For occupational medical apparel, exposure scenarios to liquids were defined based on protection needs described by the Center for Disease Control and Prevention (CDC). Based on these demands, relevant liquids were chosen to evaluate repellency and provided through testing using established test methods and by developing a new method to determine the roll-off angle for textiles. It has been found that some non-fluorinated DWRs based on green chemistry concepts showed excellent water repellence and also a resistance towards the penetration of liquids with intermediate polarity (e.g. orange juice and synthetic blood). When it comes to liquids with very low surface tension like gastric fluid evaporation, this property reduces the contact area and prevents the only materials that protected against liquid penetration. This study of chemical substitution based on chemical and textile functionality as well as end-user requirements pointed out the opportunities and limitations for functional substitution.

264 Analysis of the technical and economic feasibility of alternatives to lead gunshot

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An analysis of the technical and economic feasibility of alternatives to lead gunshot has been prepared by ECHA as part of a REACH Annex XV Restriction Report on lead and lead compounds used in shot in wetlands. Lead has historically been used in cartridges because of its softness, low melting point, high density, relatively low price and high abundance. Because of these properties, lead is often considered to be the ideal material for use in ammunition. Steel gunshot (soft iron) is by far the most common alternative; other materials include bismuth and tungsten. The alternative materials have a somewhat different ballistic behaviour, but they are still technically and economically suitable alternatives to lead gunshot. However, some adaptation is required by the shooter to use alternatives successfully, including the following: Adaptation of the shot size used as this would typically need to be increased to counter for the lower density of steel Awareness that shotguns are a sharper tool that is influenced by the ammunition performance, if fired at targets within a range of 35m Training should be done using shot of the same material as is intended for use in hunting/shooting. This suggests that, in assessing hunting/shooting success, the individual skills of a shooter are more decisive than the type of ammunition used. The fact that several countries in the EU have implemented a ban on the use of lead shot (for example Denmark and Netherlands) is evidence that alternative gunshot is suitable for both hunting activities and sports shooting. Steel shot is the most common alternative to lead gunshot due to its similar price per cartridge, making it the cheapest of the currently available alternatives. Some hunters may need to modify an existing shotgun to enable the use of steel shotgun. However, major gun manufacturers have confirmed that the vast majority of modern shotguns can fire alternative shot materials without any problem. In rare cases, a very old shotgun may need to be replaced or the hunter needs to use the more expensive bismuth or tungsten shot. The analysis of alternatives indicates that the use of alternatives to lead gunshot for hunting and shooting in wetlands is technically and economically feasible. While the availability of such alternative gunshot may currently vary across the EU Member States, it can be expected that a rise in demand triggered by an EU-wide regulatory action will be met on the supply side.

265 The road to successful substitution—case studies

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Delivering innovative products and solutions to the market is a driver for research and development. Drivers of innovation include changes in the market demand or the availability of new technology. New substances or new products are continuously being evaluated for their performance and safety in a given application. Adaptation to the market demand thus often leads to substitution in the use of one substance for another providing improved functionality. Beyond the evaluation of the product’s safety throughout its life-cycle, increased regulatory pressure such as possible changes in hazard classification plays a role in the selection of alternative candidate substances. In a limited number of cases, the evaluation of alternatives is required by regulatory frameworks, such as the authorisation process under the REACH regulation. However, substances of very high concern (SVHC) are identified solely based on their hazard profile (e.g. CMR or PBT properties), and do not consider findings from the overall safety assessment which includes an assessment of risk. Substitution driven by the hazard characterisation alone raises a number of questions in the search for alternative substances. Relevant candidates need to demonstrate equivalent or enhanced performance and functionality in the same range of applications and demonstrate a superior environmental and health profile based on their hazard properties. However, there is a concern that substitutions based on hazard criteria may lead to regrettable substitutions, for example when it is unclear if a substitution presents a benefit in terms of overall risk to human health and the environment. Comparative risk assessment may prove to be complex as the substances typically do not have the same level of testing information to characterise the hazard. In addition, exposure may occur at greater levels when the uses require higher use rates or if processing and handling lead to higher exposures. Finally, identifying a candidate substance providing a broad range of functionalities allowing substitution in all applications is challenging. Case studies are presented to demonstrate the challenges faced by R&D scientists and the need to work closely with experts in disciplines as varied as chemistry, chemical engineering, EH&S specialist and application specialists during the long search for candidate substances having to meet value chain requirements in terms of performance and EH&S profile.

Big data analysis in ecotoxicology: how to get new information out of existing data?

266 EDAPHOBASE - soil biodiversity data warehouse and its applications in ecotoxicology

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In this talk we present the soil-zoological information System EDAPHOBASE, a taxonomic-ecological database system, developed within a joined research project funded by the German Federal Ministry of Education and Research (BMBF). It combines existing taxonomical primary data on soil organisms from collections, scientific literature and reports in a data warehouse. Up to now EDAPHOBASE contains more than 500000 observations, about 300000 sites, an 140000 taxa. Data can easily be imported, quality checked, published, queried and analyzed via a web application interface. Detailed analyses can be performed with the interactive web application EDAPHOSTAT which allows species-level analysis as well as definition of reference communities. Future development of EDAPHOBASE towards a pan-European platform will focus on (1) the development of a harmonized tool for the evaluation of ecological soil quality, (2) the collection and usage of existing data from different parties all over the European Community.
Europe, (3) the provision of a reference base of the ecological quality of soils and (4) the coverage of relevant needs of as many as possible European policies. Finally, necessities for practical use in common agricultural policy, circular economy and for EU transboundary issues are discussed.

267 Diving into REACH database with Rstudio to produce input data for the USEtox model for thousands of chemicals E. Saouter, EU Commission JRC / Sustainable Assessment UNIt; F. Bignanzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; A. Gissi, European Chemicals Agency; S. Proenca, EU Commission Joint Research; P. Karametzis, European Chemicals Agency; J. Provost, European Chemicals Agency; J. Versteegh, Ecostewardship LLC.
In the context of the EU commission product environmental footprint activities (PEF) [1,2], the potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model [3]. For each single chemical, this model requires dozens of physico-chemical parameters as well as data on ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer endpoints. For PEF those data are required for thousands of chemicals, using the most up-to-date information [4,5]. The EU commission Joint Research Centre has obtained from the European Chemicals Agency (ECHA) data on more than eight thousand chemicals. These data includes all the physico-chemical properties (166'926 test results), ecotoxicity (305068 test results) and human toxicity data (41'381 test results) available in the IUCLID 5.5 database (as of May 2020). Data from the database were treated to determine unique chemical properties and toxicity indicators for thousands of chemicals. The present paper focuses on the use of REACH data to calculate chemical Effect Factors. All the REACH registration data on physico-chemical, aquatic ecotoxicity and human toxicity were exported from the IUCLID 5.5 database into individual Excel files. Each Excel file was imported into the Rstudio program [6] where data treatments / manipulations / calculation processes were performed. R allowed us to build code in step wise manner until we obtained the desired selection without impacting the structure of the original file (Excel). The final code can be released to the scientific community to be reapplied on the original files obtained from the REACH database. The ecotoxicity data extracted from the IUCLID database contained about 7500 substances covering both mono and multi-constituents as well as UVCB (Unknown or Variable composition, Complex reaction products or Biological materials). The database covers acute and chronic toxicity tests for various organisms with about 305’068 End-point study reports (ESR).

268 The effect of modelling decisions on macroinvertebrate sensitivity modelling S.v. Berg, Wageningen University & Research / Aquatic Ecology and Water Quality Management; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; C. Rendal, Unilever / Safety and Environmental Assurance Centre SEAC; E. Butler, Unilever; F. De Laender, Université de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology; A. Focks, Alterra Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra.
Main challenges in modern ecological risk assessment (ERA) lie in the simultaneous occurrence of species diversity and compound multiplicity. The recent development of trait-based sensitivity models has proven to be successful in tackling this problem. However, this methodology is one of the first of its kind, and has therefore to be approached with caution. It is clear that multiple facets of this method in a critical manner. We start by implementing the original method, which will be used as the null method when comparing the different modelling alternatives. As input data, toxicity, chemical classification, chemical characteristics, and a traits dataset are used. First, the relative sensitivity of each species to each compound is calculated. Next this relative sensitivity is averaged over all compounds belonging to the same Mode Of Action (MOA) class, resulting in a Mode Specific Sensitivity (MSS) value. Subsequently, exhaustive multiple linear regressions are made between MSS values and species traits, looking for traits which are best in explaining species sensitivity. The next step is to see the effect of different modelling decisions. As a first aspect, the effect of the used model selection criterion is studied. This is done by comparing the cross-validation error resulting from using the adjusted R² or the Akaike Information Criterion (AIC). As a second aspect, the effect of the used taxonomic level during species-trait matching is studied by comparing the adjusted R² of models resulting from species-trait matching done at family or at genus level. Third, two methods for exploiting species traits data are explored, trying to find out whether using the individual traits was performed. We allowed use of multiple traits simultaneously to achieve among the species. D counter has been mainly pointed to organisms with body sizes from 0.2mm to 3mm, but it also has been tested with larger organisms, and it can be applied either to freshwater, estuarine or marine species, being suitable in biosassays using for example, the brine shrimp Artemia salina nauplii (within width 48 h of hatching) or neonates (less than 24 h old) from Daphnia magna or D. longispina, or even Acartia tonsa nauplii. How it works? - First it is necessary to extract the characteristic signal from sets of organisms belonging to each of the species involved in the study; this is done with a software based pattern identification and recognition procedure using training sets of organisms of each species, which will provide the tools for pattern recognition in the subsequent data. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these device in biosassays do not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various biosassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

270 Ceriodaphnia is equisensitive to Daphnia and should fulfill invertebrate regulatory toxicity requirements K.A. Connors, S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; T. UCD 202 Adult Daphnia Ceriodaphnia Toxication Test requires the use of Daphnia magna or another “suitable Daphnia species, (e.g. Daphnia pulex)”. The zooplankton Ceriodaphnia dubia is not considered a standard test species for chemical registration in Europe despite the availability of ISO and USEPA standard acute and chronic test methods and its wide use and acceptance in other countries. Standard acute assays conducted with C. dubia submitted to fulfill REACH dossier can only be used as supporving or weight of evidence studies and not as key exposure. Then, simply present the battery of exposures (mixed species or single) to the device by just pouring the (ten) flask to the serialization component in the D counter device. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these device in biosassays do not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various biosassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

New approach facing new challenges in Ecotoxicology: D counter S. Abreu, University of Aveiro / Dept. Biologi & CESAM; A.M. Soares, University of Aveiro / department of Biological & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DETI / IEETA.
Routine tests in Ecotoxicology are simple, relatively inexpensive and rapid methods. They can be used to compare the sensitivity of various bioassays to chemical pollutants but data are globally missing for marine organisms. In addition, studies have mainly been focused on only one species under the same exposure, but toxicity exposure involving several species are scarce. D counter is an innovative device that can be used in ecotoxicology assays involving not only one, but also two or more different species, and proving separated data from each of the species coexisting under simultaneous exposure, whenever chronic differentiation can be achieved among the species. D counter has been mainly pointed to organisms with body sizes from 0.2mm to 3mm, but it also has been tested with larger organisms, and it can be applied either to freshwater, estuarine or marine species, being suitable in biosassays using for example, the brine shrimp Artemia salina nauplii (within width 48 h of hatching) or neonates (less than 24 h old) from Daphnia magna or D. longispina, or even Acartia tonsa nauplii. How it works? - First it is necessary to extract the characteristic signal from sets of organisms belonging to each of the species involved in the study; this is done with a software based pattern identification and recognition procedure using training sets of organisms of each species, which will provide the tools for pattern recognition in the subsequent data. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these device in biosassays do not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various biosassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (II) 58 SETAC Europe 28th Annual Meeting Abstract Book

Poster spotlight: TU001, TU002, TU003
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Assessment and management of stormwater on sediment recontamination due to metal contaminants
J. Drygoeanniak, Texas Tech University / Department of Civil Environmental and Construction Engineering; B. Rao, Texas Tech University / Department of Civil Environmental and Construction Engineering; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; M. Bejar, Texas Tech University; D. Athanasiau, Texas Tech University / Civil, Environmental, and Construction Engineering; D.D. Reible, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; B. Chadwick, US Navy Spawar Systems Center; G. Rosen, M. Colvin, SPAWAR Systems Center Pacific; R. Pini, The University of Alabama; E. Strecker, B. Steets, M. Otto, Geosyntec Consultants
There is a lack of understanding on the association of diffuse sources, such as episodic storm events, in the metal recontamination of sediments. The study objective is to define the effect of metals associated with storm events, with regards to the sediment recontamination in the Paleta Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and metal analysis. Receiving and outfall waters were monitored for sediment deposition, contaminant water, and porewater, using auto-samplers which were triggered at each location during two different seasons. Sediments collected in outfalls, deposition traps and sediment deposits were also subjected to chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050A and 3050B, respectively, and were analyzed using ICP-MS and MERX-T. The samples were analyzed for a variety of metals including Pb, Cd, Th, and Ti, to evaluate the potential particulate and dissolved metal concentrations in the soils, did not differ for both Pb(NO\textsubscript{3})\textsubscript{2} spiked and aged soils. Pb(NO\textsubscript{3})\textsubscript{2} concentrations in the surviving animals. Pb(NO\textsubscript{3})\textsubscript{2} concentrations in the soils, did not differ for both Pb(NO\textsubscript{3})\textsubscript{2} spiked and aged soils. Pb(NO\textsubscript{3})\textsubscript{2} concentrations in the soils, did not differ for both Pb(NO\textsubscript{3})\textsubscript{2} spiked and aged soils. Pb(NO\textsubscript{3})\textsubscript{2} concentrations in the soils, did not differ for both Pb(NO\textsubscript{3})\textsubscript{2} spiked and aged soils. Pb(NO\textsubscript{3})\textsubscript{2} concentrations in the soils, did not differ for both Pb(NO\textsubscript{3})\textsubscript{2} spiked and aged soils.

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To leach or not to leach: Soil enzymatic responses to metal mixture species
F. Awuah, University of Saskatchewan / Toxilogic Centre; S. Siciliano, University of Saskatchewan / Department of Soil Science; B.A. Hale, University of Guelph / School of Environmental Sciences
Presentation Type: Presentation preferred Abstract Title: To leach or not to leach: Soil enzymatic responses to metal mixture species Authors: F. K. Awuah\textsuperscript{1}, B. Hale\textsuperscript{2} & S. Siciliano\textsuperscript{1}; University of Saskatchewan, Toxilogic Center; \textsuperscript{1}University of Guelph, School of Environmental Sciences. Abstract: In soil laboratory experiments, metal mixture studies are usually carried out with metals dosed as salts, followed by leaching with artificial rainwater to remove excess salts. In the leaching process, metals are lost unequally, which affects the ratio of the mixtures in the soil. An efficient way of carrying out metal mixture experiments is by using the fixed ratio ray design. This design reduces the amount of experimental effort and allows the estimation of both additivity and interactions. In using this design, metal concentrations should be fixed in specific ratios, but this is compromised when soils are leached. Hence, an alternative method of dosing that allowed fixed ratio testing had to be determined. Two proposed alternatives were metal oxides and spinel minerals which were both abundantly found in aged salt spiked soils and field metal contaminated soils. The toxicity of the oxides and minerals to soil enzymes were tested and compared to the salts. The experiment was conducted with three Canadian soils (pH 3.5-7), three metal species, five fixed metal(loid) mixtures, and five metals (Pb, Cu, Co, Ni, Zn) at one dose. The activity of the soil enzymes ammonia monoxygenases, beta-glucosidases, acid-phosphatases and arylsulphatases were determined colorimetrically. Results showed that leaching alone significantly inhibits the enzyme ammonia monoxygenases in all three soils. The response of acid phosphatases to the metal mixture rays followed known paradigms of bioaccessible concentrations defining toxicity. However, the response of ammonia monoxygenases followed a different toxic pathway (hormetic toxicity) in all three soils. Here, ray toxicity was highest in the soil with a pH value of 5 and vice versa for pH 3 and 7. Generally, metal salts were the most toxic form, and the spinel minerals were the least toxic. Metal oxides were chosen as a replacement for carrying out metal mixture studies in soils because no leaching was required and it was more toxic than the minerals. Keywords: Fixed ratio ray, metal oxides, spinel minerals

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Soil moisture influences the avoidance behaviour of Folsomia candida and Enchytraeus crypticus in metal(loid)-contaminated soils
M. Haque-Alkargi, University of Saskatchewan / Department of Biology & CESAM; M. University of Aveiro / Bio & CESAM; C. Malheiro, Department of Biology, University of Aveiro / Biology; D. Nunes Cardoso, CESAM, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology
This study aimed to assess the effects of soil moisture content on the avoidance behaviour of the soil invertebrate species Folsomia candida (arthropod) and Enchytraeus crypticus (soil-fauna). Soil mixture experiments were usually carried out with metals dosed as salts, followed by leaching with artificial rainwater to remove excess salts. In the leaching process, metals are lost unequally, which affects the ratio of the mixtures in the soil. An efficient way of carrying out metal mixture experiments is by using the fixed ratio ray design. This design reduces the amount of experimental effort and allows the estimation of both additivity and interactions. In using this design, metal concentrations should be fixed in specific ratios, but this is compromised when soils are leached. Hence, an alternative method of dosing that allowed fixed ratio testing had to be determined. Two proposed alternatives were metal oxides and spinel minerals which were both abundantly found in aged salt spiked soils and field metal contaminated soils. The toxicity of the oxides and minerals to soil enzymes were tested and compared to the salts. The experiment was conducted with three Canadian soils (pH 3.5-7), three metal species, five fixed metal(loid) mixtures, and five metals (Pb, Cu, Co, Ni, Zn) at one dose. The activity of the soil enzymes ammonia monoxygenases, beta-glucosidases, acid-phosphatases and arylsulphatases were determined colorimetrically. Results showed that leaching alone significantly inhibits the enzyme ammonia monoxygenases in all three soils. The response of acid phosphatases to the metal mixture rays followed known paradigms of bioaccessible concentrations defining toxicity. However, the response of ammonia monoxygenases followed a different toxic pathway (hormetic toxicity) in all three soils. Here, ray toxicity was highest in the soil with a pH value of 5 and vice versa for pH 3 and 7. Generally, metal salts were the most toxic form, and the spinel minerals were the least toxic. Metal oxides were chosen as a replacement for carrying out metal mixture studies in soils because no leaching was required and it was more toxic than the minerals. Keywords: Fixed ratio ray, metal oxides, spinel minerals

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Manganese bioavailability in legacy contaminated soils by medieval environmental realism of laboratory toxicity studies.
metallurgical wastes

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In our study, we report that soil properties are influenced by the presence of metal resources through mining and metallurgical activities, for instance, lead (Pb), silver (Ag), or iron (Fe). However, they can lead to a significant environmental contamination through the emission of metal-rich particles and wastes in the region. In the Burgundy Franche-Comté (eastern France), iron mining and metallurgical activities were dominant over the Middle Age period, especially in the ancient district of Beaune. Preliminary analyses highlighted anomalous manganese (Mn) concentrations in soils surrounding medieval slag heaps. Therefore, this study aims at assessing the origin and fate of this Mn using combined physical, chemical and biological tools. For this purpose, we carried out three interdisciplinary and complementary approaches: i) mineralogical characterisation of slags; ii) chemical extractions for the assessment of total and available Mn concentrations in soils and iii) environmental bioavailability of Mn using toxicityokinetics (28 days) in Cantareae aspersa snails exposed to soils from 10 ancient sites of slag deposit (dated from the 5th to the 11th century) or fed with slag fragments incorporated in their diet. We identified olivine (fayalite) as the main Mn carrier in slags where its concentration ranges between 4.5% and 5% MnO. With time, slag weathering, as testified by the formation of secondary minerals and smelting residues, lead to a release of Mn which accumulates in soils (up to more than 8000 mg kg⁻¹). Extractible concentrations of Mn from soils (mainly bound to organic matter and under reducible forms) are elevated and may represent a potential toxic stress to soil invertebrates, raising the question of Mn bioavailability in soils and slag fragments. The modeling of Mn accumulation kinetics in C. aspersa snails tissues allowed to show that new Mn assimilated is either sequestered in the soft tissues or released in the soil invertebrates and ii) the snail ability to efficiently regulate this element. Nevertheless, when animals are directly exposed to slag fragments incorporated in their diet, the physiological mechanisms of Mn management are rapidly overloaded and internal concentrations increase up to 3000 mg kg⁻¹. Hence, in slag, although often considered as inert materials, Mn turns out to be bioavailable to snails, particularly through their alteration in situ (field) and in vivo (digestive tract).

277 Chemical and ecotoxicological effects of the use of residues from the pulp and paper industry for the remediation of soils degraded by mining activities

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Biomass ash and biological sludge, both residues from the pulp and paper industry, in different mixture formulations, with and without the application of mixed municipal solid waste compost (MSWC), were used to improve the quality of soils affected by mining activities (Aljustrel mine, Iberian Pyrite Belt). The experiments comprised: i) the primary amendments, to allow their availability in soil, and a pot experiment, with Agrostis tenaivar Sibth, to evaluate the possibility of establishing a plant cover in the amended soils. The effects on soil quality were assessed evaluating: i) soil chemical properties, ii) plant growth, iii) immobilization of metals in the soil, iv) the effects of the amendments on soil eluates toxicity, using organisms from different trophic levels: luminescence inhibition of Vibrio Fischeri; 24-h mortality test with Thamnocephalus platypterus; 72-hours population growth of the green microalga Pseudokirchneriella subcapitata; and Daphnia magna acute immobilization test; and v) soil dehydrogenase activity. Contrary to non-amended control pots, it was possible to establish a plant cover with A. tenaivar in pots where correctives were applied, but with some variability between replicates. Phytotoxicity was observed in some of the pots relating to the compounds/elements, to assess their availability in soil and to carry out a microbiological analysis, in comparison to non-amended soils (controls) was further evidenced by the increase in the activity of dehydrogenase. The amendments were also able to correct soil acidity, and to increase extractable P and K. However, a significant increase in the organic matter, and N content, was only possible by the simultaneous application of MSWC, leading to the decreased soil pH in comparison to non-amended soils (controls) and decreased the higher application rates of the correctives, due to a dilution effect. In general, amending the soil with biomass ash and biological sludge decreased the toxicity of soil eluates towards the organisms used. The formulation with 30% of biological sludge (applied in 2.5, 5.0 and 10%, w/w, dry matter), presented a better performance, although inducing a slight toxic effect in the microalgae. Concerning the amendment with MSWC, and despite its beneficial chemical effects, toxicological results did not reflect this improvement, since the presence of MSWC did not promote the decrease of toxicity towards the microalgae. Further research is needed with different plant species, since Agrostis tenaivar showed some phytotoxicological response.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (II)

278 Profile of microplastics in water and sediments of Antúnez river in Portugal

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The accumulation of plastics in aquatic systems, especially, microplastics (particles with < 5 mm) is of particular apprehension since they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. These microplastics (MPs) differ in their physico-chemical properties (e.g. size, shape, colour, density and polymer type) as well as in their origin (primary or secondary). Notwithstanding, the occurrence of microplastics (MPs) in freshwater systems is less understood than in marine environment. Hence, the present study aims to fill this knowledge gap providing new insights into MP contamination in Antúnez river in water and sediment samples collected in March and October of 2016 in several stretches of the river. The abundance of MPs reached 14.3 ± 18.3 mg m⁻³ or 306.4 ± 472.1 items m⁻³ in water samples and 35.8 ± 25.7 mg kg⁻¹ or 318.9 ± 246 items kg⁻¹ in sediments. It shows that this river is severely influenced by MPs, especially in water compartment. Spatial and temporal distributions show different pattern according to seasonal conditions, proximity to urban areas and flow velocity. The water and sediment samples with the greatest abundances were São João da Madeira and Aguincheira, respectively. In water compartment, the highest abundance of MPs was observed in October, while in sediments an opposite pattern was observed. Analysis of plastics by Fourier transform infrared spectroscopy (FTIR) underlines polyethylene (PE) and polypropylene (PP) polymers as the most common types covering more than 50% of all polymer types identified. Furthermore, the low medium high oxidation ratio for these particles were 54:38:8 indicating that fewer particles are highly oxidized. Foams and fibers were the most abundant type in São João da Madeira, while fibers and fragments are the most abundant in Aguincheira and Estarreja in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (~ 1 mt) and 10%-50% of plastic go to landfills, it is urgent to monitor its freshwater systems. This study emphasizes also the importance of rivers as potential carriers of MPs within environment. Further studies should be performed to identify point sources in order to mitigate the MP contamination in aquatic systems.

279 Microplastics in German rivers - first monitoring results

M. Hess, LANUV NRW / Water management, water protection; C. Laurisch, University of Bayreuth; P. Diehl, State Environment Agency Rhineland-Palatinate; H. Imhof, University of Bayreuth / Animal Ecology I; M. Loeder, University of Bayreuth; J. Mayer, Hessian Agency for Nature Conservation, Environment and Geology; H. Rahm, North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection; W. Reichenhäuser, Bavarian Environment Agency, Wielenbach; I. Schrank, University of Bayreuth; J. Stark, State Institute for Environment, Measurements and Nature Conservation Baden-Württemberg; J. Schweizer, Bavarian Environment Agency / Aquatic Toxicology and Pathology Plastics are an indispensable component of our daily lives due to their diverse applications. In consequence of improper handling or disposal, plastics can enter surface waters and persist over a long period due to their low degradability. About 4.8 to 12.7 million tonnes of plastic waste are released into the oceans each year. Rivers and wastewater discharges may contribute significantly to the contamination of the marine environment. Despite an obvious causal link between the (micro)plastic load of inland waters and marine ecosystems, European rivers have been investigated for the presence of microplastics (MPs) only recently. However, the analytical results of different studies are usually not comparable among each other due to different methods of sampling, processing and analysis of microplastics. In Germany, five federal states initialised monitoring programmes to get a first overview on the microplastic load of inland water systems: Baden-Württemberg, Bavaria, North Rhine-Westphalia, Hesse and Rhineland-Palatinate in cooperation with the University of Bayreuth. Monitoring was performed in terms of both surface water and wastewater discharges. The programme comprised microplastic monitoring in two large river basins (Rhine and Danube), including tributaries of various sizes, thereby covering a wide range of hydrological conditions and anthropogenic influences. A total of 52 measuring points distributed over 25 rivers and streams were examined for MPs near the water surface. MPs were sampled via MantaTrawl and analysed by FTIR spectroscopy. The analysis of samples out of these two methods could be clearly identified as plastic particles and were characterized in terms of polymer type, size and shape. To our knowledge, the study of the five federal states in cooperation with the
280 Exploring the relation between plastic concentration and river discharge in an urban river
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Rivers play a major role in transport of plastic debris from inland sources into the marine environment. Presently the relevance of various individual sources and emission pathways of plastic in rivers such as wastewater treatment plants, combined sewer overflows, surface runoff and littering can hardly be quantified. Therefore plastic emission from sub-catchments are determined by integral approaches. This study examines plastic particle concentration upstream (P1) and downstream (P2) of an urban subcatchment and establishes relationships between river discharge and plastic concentration (c-Q relationship). Suspended material > 500 µm was sampled at two sampling sites in the Parthe River, (Leipzig, Germany) upstream (P1) and downstream (P2) of an infrastructure and no different discharge conditions during 17 campaigns each for 24 h. Plastic material was extracted and quantified in the suspended matter using particle size fractionation, density separation and particle cleanup followed by Raman spectroscopy. Plastic particle mass and number concentration were determined and it was observed that plastic concentration and load increased in the urban subcatchment. To explain the observed concentration and load increase, load plastic input in both sub-catchments was related to the catchment attributes population, catchment size, urban area, and river length revealing that population determines plastic emissions. The log-log c-Q plots of total plastic mass and particle number concentrations show an enrichment pattern at P2, hence increasing concentration with increasing discharge (positive slope b of the regression). At P1 no significant c-Q relationship was observed. This indicates that the urban sub-catchment increasing discharge does not drive an increased mobilization of plastic material. The c-Q relationship was applied to estimate the yearly plastic emission based on river discharge data.

281 Microplastic pollution in upstream river catchments
T. Stanton, M. Johnson, P. Nathanial, The University of Nottingham / School of Geography; R.L. Gomes, The University of Nottingham / Faculty of Engineering; W. Macnaughton, The University of Nottingham / School of Biosciences

Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally. Microplastics are often associated with wastewater treatment plants and centres of population and industry. However, the extent to which they pervade upstream catchments is comparatively underrepresented in the study of freshwater microplastic pollution. Results presented here form part of a year-long project that aims to quantify the spatial and temporal variation of microplastic pollution in rural headwaters and urban rivers that do not receive wastewater treatment effluent across England’s Midlands, as well as in atmospheric fallout. FTIR analysis of three months’ samples identified microplastic particles in 30 litre water samples taken from the headwaters of the River Trent and its tributaries. It has also been used to identify non-fibrous microplastic fragments in rural and urban atmospheric fallout. Moreover, spherical particles that resemble those used in cosmetic / personal care products have been identified in rivers that do not receive wastewater treatment effluent, some of which have proven not to be polymer-based following FTIR analysis. This brings into question the source, and chemical composition, of spherical particles that have previously been visually identified as plastic spheres likely derived from cosmetic particles. The findings of this study have identified the need for the more extensive consideration of upstream catchments and reaches of rivers not associated with wastewater treatment plants in the study of freshwater microplastic pollution. The work conducted here suggests that, though wastewater treatment facilities and large centres of population and industry are suitable predictors of microplastic pollution, the cumulative contribution of headwaters and tributaries are likely to influence a river’s microplastic load.

282 Microplastics in stormwater ponds
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Stormwater runoff contains pollutants from land surfaces. As the majority of production and consumption of synthetic polymers is happened on land, microplastic (MP) is one group of problematic pollutants in urban stormwater runoff. However, MPs in stormwater has barely been investigated. A large part of the urban stormwater runoff is treated in retention ponds prior to discharge. This study looked into the occurrence, composition and concentration of MP in stormwater ponds, aiming to evaluate the retention efficiency of MP by these systems. The results will contribute to the understanding of MP emission from urban areas, and potential impacts on adjacent environmental compartments. Seven stormwater ponds in Denmark were selected as study sites. Surface water was collected using a pumping system equipped with a 10 µm mesh stainless steel filter. Sediment samples were collected using an Ekman bottom grab sampler. The filters from the water samplings were pre-oxidized by H₂O₂, followed by enzyme treatment. secondary oxidation was applied afterwards. Inorganic particles were separated by density separation using ZnCl₂. Sediment samples were freeze dried and incubated in SDS solution. Enzymes were then added, followed by chemical treatments. Inorganic materials were separated by density separation using ZnCl₂. After extraction, particles (from 10 to 2000 µm) were concentrated in 50% ethanol solution. A sub-sample was deposited onto a ZnSe window and dried. The window was scanned by micro-Fourier Transformed Infrared Spectroscopy imaging applying an Agilent Cary 620/670 system with a 128x128 pixel FPGA. The software MPhunter was used to interpret spectrums. MPs were detected in water phase of all ponds. The most abundant polymers were PP, PE and PS. The highest concentration in terms of particle number was 10.8 particle/L, while the other 6 ponds ranged from 0.07 to 2.45 particle/L. For MP mass the highest concentration was 1.2 µg/L while the other 6 ponds ranged from 0.06 to 0.4 µg/L. High density polymers were also detected in some of the ponds, this is likely due to the resuspension of sediment by wind and traps of MPs by organisms. Sediment samples are still under processing and will be included in final presentation. Nevertheless, the water samples have shown that stormwater pond do not detain all MPs, particularly for low-density polymers. With the high mobility, discharges from stormwater ponds will potentially affect adjacent environmental compartments.

283 Towards a more realistic assessment of microplastics as pollutant transporter: a combined experimental and modelling study
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Freshwater environments are contaminated with various compounds. In such systems, hydropobic organic contaminants are often associated with particles such as microplastics (MP) which are ubiquitous detected and have raised concern. The release of pollutants from such particles is a combination of two different diffusive fluxes. External mass transfer governed by diffusion through an aqueous boundary layer on the one hand and internal mass transfer limited by the interparticle diffusion coefficients on the other hand. The mass transfer proceeds by mechanisms that controls the kinetics depends on various factors, such as partition coefficients, particle properties, boundary conditions, and time. The aim of this study was to identify if and how observations of pollutant release from MP under laboratory conditions can be transferred to field conditions. We formulated a coupled mass-transfer model to consider both, external and internal mass transfer, and combined an analytical solution with Laplace transformation. For model evaluation, we performed batch experiments with different wastewater contaminants with varying hydrophobicity and at different amounts of dissolved organic matter, which changes the overall partitioning between the MP and the water phase. We measured equilibrium partition coefficients and release kinetics over 240 hours. Based on experimental data and the analytical solution of the model, characteristic times of mass transfer were calculated. These are proxies for the equilibration time and can be used to assess the relative importance of the two mass-transfer processes. Results show, that mass transfer for hydrophilic compounds usually is limited by intraparticle diffusion whereas for hydrophobic compounds it is externally limited. For intermediate compounds, a shift from internal to external dominance was observed. Calculated characteristic times show that under lab conditions the overall equilibration time decreased with increasing partition coefficient while under field conditions the opposite is the case. Thus, a simple first-order approximation of mass transfer would not be enough to transfer experimental results to field conditions adequately. Rather, it is necessary to consider true intraparticle diffusion. Application of our model to different particle sizes, shapes, materials and for varying particle concentrations underlines the fundamental differences between lab and field and allows the transferability between these different boundary conditions.

Air Pollution, Biomonitoring and Human Health (II)

284 Analysis of the contribution of a coal-fired power plant to PM10 concentrations in four sites in Southern Italy
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This study is aimed to perform a source apportionment of PM10 collected simultaneously in four sites located in the Puglia region (South-Eastern Italy). The
Air pollution toxicology: is it the right time to leave the bench for the field? A case study integrated approach

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Air pollution (AP) is recognized as the most important environmental issue affecting human health. In Europe AP is responsible for 500,000 premature deaths mainly due to non-communicable diseases and disabilities. The epidemiological associations have already evidenced significant relationship between increases in risk factors for selected human diseases and air pollutants concentration. Finally IARC has classified outdoor air pollution as carcinogenic to humans (Group 1). During the last decades several toxicological studies have investigated the mechanisms of action of air pollution on health and on its interaction with matter (PM). These studies worked mainly with in vitro or in vivo models exposed to PM samples previously collected on filters, then detached and resuspended in suitable media. This procedure, although extensively applied, has always posed the question about the representativeness of extracted PM in comparison to airborne PM. However, the lack of exposure systems directly working under environmental conditions made this experimental set-up widely accepted. In the last years, also thank to Nanotoxicology studies, innovative exposure modules have been proposed which are able to convey air-dispersed particles on cultured cells. The majority of the application so far reported, however deal with the exposure under laboratory condition of engineered nanoparticles or other molecules of interest. Here we report the results obtained by the validation of the biological endpoints of culturing A549 at the air-liquid-interface (ALI) under environmental condition to environmental pollution by means of an exposure module (CULTEX® RFS module). The data demonstrate that the maximal feasible exposure evaluated for the CULTEX® system is representative of the dosimetry calculated for human exposure. The toxicological evaluation evidenced the absence of cytotoxic effects and absence of significant inflammatory response associated to exposure on the differential expression of selected genes of interest. Altogether our results show that the time is arrived to leave the warmth of the laboratory bench and to start toxicological evaluation in field campaign. Although the proposed approach still require an extensive evaluation to assess all the pros and cons we reckon that the toxicological data obtainable under really representative environmental conditions may be more representative to understand the biological processes activated by air pollution.

Indoor and Outdoor air contamination by endocrine disruptor pollutants in the North part of France

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The atmosphere is the main environment with which humans have the most important exchanges. However, human activities (house, body, home, automobile, work, etc.) are the primary cause of a broad range of pollutants. To date, few data exist on air contamination by endocrine disruptor compounds (EDCs) in France. With the experience acquiring in Paris region in a previous research, the research team and ATMO Hauts-de-France realised two studies in the North part of France about indoor and outdoor air contamination by EDCs. According to the method previously validated several types of indoor environments (office, house, scholar building and day nursery) and several areas (rural/forest, urban, industrial) were investigated over 2 years (2015 and 2016-2017). During each season, 7 or 5 sites (indoor and outdoor) were sampling during three successive 2-week periods. The device is composed to a TSP filter system and a cartridge containing XAD resin, connected to a flow meter and a pump. 70 EDCs were analysed by LC-MS/MS. GC-MS/MS in gaseous and particulate phases separately. Whatever the site, in outdoor air as well as in indoor air, all EDCs were detected and concentrations range from 33.553 to 0.001 ng/m³. Phthalates, PAHs, musks and alkylphenols are the main compound families. Urban and industrial sites are more concentrated than rural and forest ones. Furthermore, for most pollutants, indoor air is more contaminated than outdoor. The measured concentrations of EDCs depend directly on potential sources of emission, on activities inside the building and urban density. For example, phthalates concentrations are linked to consumer products, building materials, furnishing... PAHs are coming from residential and tertiary heating and from road transport; alkylphenols and musks from detergents. Excepted few specific sites, the EDCs concentrations in air in the North part of France are in the range of what is observed in different areas. This approach allows by EDCs is becoming a sanitary concern because French people spend 80% of time in indoor environment and young children, a particularly sensitive population, are the most exposed.

287 Air pollution and health: early biological effects in children exposed to air pollutants and genotoxic effect of PM0.5 in different Italian towns

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Air pollution (AP) is recognized as the most important environmental issue affecting human health. In Europe AP is responsible for 500,000 premature deaths mainly due to non-communicable diseases and disabilities. The epidemiological associations have already evidenced significant relationship between increases in risk factors for selected human diseases and air pollutants concentration. Finally IARC has classified outdoor air pollution as carcinogenic to humans (Group 1). During the last decades several toxicological studies have investigated the mechanisms of action of air pollution on health and on its interaction with matter (PM). These studies worked mainly with in vitro or in vivo models exposed to PM samples previously collected on filters, then detached and resuspended in suitable media. This procedure, although extensively applied, has always posed the question about the representativeness of extracted PM in comparison to airborne PM. However, the lack of exposure systems directly working under environmental conditions made this experimental set-up widely accepted. In the last years, also thank to Nanotoxicology studies, innovative exposure modules have been proposed which are able to convey air-dispersed particles on cultured cells. The majority of the application so far reported, however deal with the exposure under laboratory condition of engineered nanoparticles or other molecules of interest. Here we report the results obtained by the validation of the biological endpoints of culturing A549 at the air-liquid-interface (ALI) under environmental condition to environmental pollution by means of an exposure module (CULTEX® RFS module). The data demonstrate that the maximal feasible exposure evaluated for the CULTEX® system is representative of the dosimetry calculated for human exposure. The toxicological evaluation evidenced the absence of cytotoxic effects and absence of significant inflammatory response associated to exposure on the differential expression of selected genes of interest. Altogether our results show that the time is arrived to leave the warmth of the laboratory bench and to start toxicological evaluation in field campaign. Although the proposed approach still require an extensive evaluation to assess all the pros and cons we reckon that the toxicological data obtainable under really representative environmental conditions may be more representative to understand the biological processes activated by air pollution.

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implementing policies of public health protection.

Source apportionment of PM near steel plant by electron microscopy

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Source apportionment based on bulk chemical analysis often uses advanced statistical tools for a detailed source categorization. In contrast, in this study the source apportionment is based on properties of individual particles determined by scanning electron microscopy with energy-dispersed spectrometry (SEM-EDS).

The receptor site is located near a steel plant in the Apulia Region, South Italy. A total of 5000 particles were analyzed by SEM-EDS and based on the morphology and chemical composition they have been classified into the following main groups: Aluminosilicate particles; Silicium rich particles; Ca-rich particles; Biological particles; Carbonaceous particles; Soot; Kish flakes; Salts of Sodium Chloride (sea salt); Calcium sulfate; Metal particles; Secondary particles; Fe reach particles (Fe mixture and Fe oxides). All particles, which could not be classified into one of these groups, were listed as other particles. The particle groups observed in the present investigation can be assigned to different emission sources. Beside the chemical composition, information on the morphology and mixing state of the particles is helpful for discrimination of industrial emissions originating from high temperature processes from a natural soil component, for both iron-rich particles as well as silicates. In the present study, the following source categories have been distinguished: soil, industrial, secondary, biological, soot, Ca-rich particles. In industrial, soil and secondary, particles of different groups are merged.

The source apportionment analysis performed with the single particle analysis let to investigate the dimensional and mass distribution of the sources in PM10-2.5, PM2.5-1, PM1 fractions, showing that the inorganic ones are mainly present in the fine and ultrafine particles, while the natural sources are characterized by coarse dimension.

Oxidized transformation products of polycyclic aromatic hydrocarbons in secondary organic aerosol particles

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Long-range atmospheric transport of polycyclic aromatic hydrocarbons (PAHs) in fine particulate matter (PM2.5) remains a global concern as transport models continue to fail short of accurate predictions. To improve modeling accuracy the determination of chemical speciation of PAHs within PM2.5 is necessary. Secondary organic aerosol (SOA) particles sorb PAHs during formation and transport them as a large fraction of global atmospheric PM2.5, and the presence of PAH vapor has been demonstrated to increase the mass loading of atmospheric SOA. The oxidation of four PAHs was studied in laboratory generated α-pinene SOA experiments. Dibenzo(a,h)anthracene (DBT), phenanthrene (PHE), pyrene (PYR), and benz(a)anthracene (BaA) were measured along with their oxidation products in freshly formed α-pinene ozonolysis SOA grown in the presence of vapor phase PAH (PSOA). Ratios of oxidized transformation products was measured and changes in those ratios was observed during the aging of the SOA, as well as after exposure to ozone. In freshly formed PSOA, the sum of measured oxidized products was found to be equal to the measured amount of parent compound in all four systems. Characterization of aged particles provides evidence of continuing chemical reactions in PHE and PYR PSOA. DBT and PHE PSOA showed evidence that ozone exposure, performed in a flow-tube reactor, results in further oxidation. Data suggests the environment inside SOA particles are complex and dynamic, and need to be further explored. Implications of the presence of oxidized PAHs in long-range transport modeling will be discussed.

The added value of using invertebrate species in ecotoxicology: new insights for environmental risk assessment (II)

The role of the p38-activated protein kinase signaling pathway-mediated autophagy in cadmium-exposed monogonont rotifer Brachionus koreanus

H. Kang, C. Jeong, J. Lee, Sungkyunkwan University

The role of the p38-activated protein kinase (MAPK) in response to Cd-induced oxidative stress, leading to the induction of autophagy in B. koreanus. This was further verified by analysis of MAPK protein levels and immunofluorescence of LC3 II/I after treatment with reactive oxygen species scavengers and inhibitors specific to MAPKs. We propose a p38 MAPK-mediated regulatory mechanism of autophagy in B. koreanus in response to Cd-induced oxidative stress. This study will contribute to a better understanding of autophagic processes in invertebrates and its modulation by environmental stressors.

Effects of triclosan (TCS) on antioxidant system and oxidative stress-mediated gene expression in the copepod Tigriopus japonicus

J. Paik, J. Lee, Sungkyunkwan University

Triclosan (TCS) is an antimicrobial agent that has been widely dispersed and detected in the marine environment. However, the effects of TCS in marine invertebrates are poorly understood. In this study, the effects of TCS on life cycle parameter (e.g. mortality and fecundity) along with cellular reactive oxygen species (ROS) levels, GSH content, antioxidant enzymatic activities, and mRNA expression levels of oxidative stress-induced defense genes, were analyzed using model marine copepod Tigriopus japonicus. The no observed effect concentration (NOEC) and median lethal concentration (LC50) of TCS in the adult stage were determined to be 300µg/L and 437.47±µg/L, respectively, while in the nauplius stages the corresponding values were 20µg/L and 51.76±µg/L, respectively. Fecundity was significantly reduced (P < 0.05) in response to TCS at 100µg/L. Concentration and time-dependent analysis of ROS, GSH content (%), and antioxidant enzymatic activities (e.g., GST, GR) shows that they were significantly increased (P < 0.05) in response to TCS exposure. Furthermore, mRNA expression of detoxification (e.g., CYPs) and antioxidant (e.g., glutathione S-transferase-sigma isoforms, Cu/Zn superoxide dismutase, catalase) genes was modulated in response to TCS exposure at different concentrations over a 24 h period. Our results revealed that TCS can reduce fecundity and induce oxidative stress with transcriptional regulation of oxidative stress-induced defense genes along with the activation of the antioxidant system in the copepod T. japonicus. Based on our investigation, TCS affects survival through oxidative stress with antioxidant and detoxification defense system in T. japonicus. In addition, two CYP genes (CYP3026L3 and CYP3037A1) are likely to have a potential role as biomarkers in response to TCS in T. japonicus. This study will be helpful for a better understanding of how TCS affects antioxidant defense and detoxification mechanisms in copepod.

The protective role of multixenobiotic resistance (MXR)-mediated ATP-binding cassette (ABC) transporters in biocides-exposed rotifer Brachionus koreanus

Y. Lee, H. Kang, C. Jeong, J. Lee, Sungkyunkwan University

In aquatic organisms, cellular membranes act as the final physical barrier to xenobiotics, since the membranes are in constant contact with the ambient water column that contains various anthropogenic pollutants. In this respect, the efflux activities of membrane transporters can be considered as the first line of defense to xenobiotics, by expelling these substances out of the cells. For this study, the protective role of P-gp and MR in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, chlorpyrifos, endosulfan, and endosulfan sulfate) on P-glycoprotein (P-gp) and multidrug resistance-associated protein (MRP) are ATP-binding cassette (ABC) transporters that confer multixenobiotic resistance (MXR) via their efflux activity, which enables a variety of xenobiotics to be expelled from cells. MXR has been proposed as the first line of defense against xenobiotics. In this study, the protective role of P-gp and MRP in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, chlorpyrifos, endosulfan, and endosulfan sulfate) using fluorescent substrates and inhibitors specific to P-gp and MRP. The efflux activities of P-gp and MRP in the rotifer B. koreanus were increased by biocide exposure, since the fluorescence intensities of the accumulated P-gp and MRP fluorescent substrates were lower in response to different biocides. Thus, exposure of rotifers to the four biocides resulted in increased P-gp and MRP activity. Moreover, the rotifers became more sensitive to the biocides, with reduced survival and slower population growth rates, when P-gp or MRP was inhibited. These findings suggest that P-gp and MRP are involved in the defense system in response to biocide exposure. Furthermore, the transcriptional levels of the genes encoding P-gp and MRP were examined to uncover the mechanism by which MXR is induced. Taken together, our results demonstrate the important role of the MXR efflux system in the defense response to biocides, thereby providing a better understanding of rotifer defense mechanisms on the molecular level.
ecotoxicological species have allowed us to determine the mechanisms of action of many chemical contaminants. There is, however, the need for validated physiological studies applying reverse genomic tools. Here we present results on six CRISPR-Cas9 mutated Daphnia magna clones: three of them bearing mutations on the tryptophan hydroxylase gene (TRH), the rate limiting enzyme of serotonin synthesis, and other three having the transporter protein gene ABCB1 mutated. Bi-allelic and del TRH mutants lack serotonin and have their growth rates impaired. Bi-allelic indel ABCB1 imutants had lower transmitter activity. Chronic toxicity tests with the selective serotonin reuptake inhibitor fluoroxetane indicated that effects of this drug enhancing offspring production was independent of serotonin. Acute toxicity test indicated that the transporter ABCB1 is involved in the detoxification of ivermectin and its total or partial knockout dramatically increased its toxicity. These results provide the first evidence over for the use of reverse genetics in Daphnia to study the mechanisms of action of toxicants opening new avenues of research in a stress physiology perspective. This work was supported by the Spanish Government grant (CTM2014-51985-R).

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Assessment of Effects and Recovery of Chaoborus Populations in a Novel-Concept Microcosm Experiment
C. Gamblin, R. Cockroft, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco

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Toxic mixtures in time-the sequence makes the poison
R. Ashauer, University of York / Environment

It is generally agreed that “the dose makes the poison”—that chemicals can be toxic or non-toxic depending on their dose. This principle assumes that once a chemical is cleared out of the organism (toxicokinetic recovery), it no longer has any effect. The impact of mixtures (Brack et al. 2015, STOTEN 503:22) deconstructed the general challenge into three questions (i) How to identify priority mixtures, (ii) How to identify drivers of mixture risk, (iii) How to measure Effect. The presence of mixtures (Brack et al. 2015, STOTEN 503:22) deconstructed the general challenge into three questions (i) How to identify priority mixtures, (ii) How to identify drivers of mixture risk, (iii) How to measure Effect. The presence of mixtures is a source of adult insects for recolonisation of the treated systems by a distance of 100 m and non-invasive monitoring of larvae and pupae. The test material was applied at a single rate on two occasions with a 14-day interval to ten microcosms containing predominantly egg rafts and post-overwintering fourth instar larvae of Chaoborus obscursus. Ten untreated microcosms with similar populations of Chaoborus were established upwind of the treated units and these, together with indigenous Chaoborus, served as a potential source of adult insects for re-colonisation of the treated units. Three microcosms in each group were covered with insect-proof netting to prevent natural re-colonisation in order to assess the extent of population recovery from within microcosms. The numbers and developmental stages of larvae along with the numbers of pupae and presence and numbers of egg rafts were monitored throughout the study using non-invasive methods, from the week before the first application in May 2017 to the end of August 2017. These assessment methods were successful in enumerating the larvae, pupae and extent of adult emergence over time. The findings from the study show that the early instar larvae of Chaoborus filtered out the least contaminants from the microcosms, the middle instars were impacted by contaminants, and that later instars were able to survive and pupate, and that adults emerge. Recolonisation was relevant to the ‘open-field’ given that the control microcosms were a substantial distance (100 m) from the treated microcosms. The results show that populations impacted by synthetic pyrethroids are re-established in less than 8 weeks after the first application.

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Poster spotlight: TU108, TU109, TU110

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (II)

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Linking chemical pollution and effects – How to identify drivers of toxicity?
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European water resources are contaminated with complex mixtures of tens of thousands of chemicals among them many non-regulated compounds with emerging concern but also unknown chemicals. Chemical monitoring, however, typically considers only a very small fraction of chemicals focusing on 45 priority substances according to Water Framework Directive (WFD) together with some additional River Basin Specific Pollutants. These chemicals often do not explain effects in toxicity tests and impacts on freshwater communities. Thus, we suggest a consistent tiered approach to identify drivers of toxicity in complex environmental mixtures employing mass balance and multivariate statistical approaches as well as effect-directed analysis. The approach is demonstrated using several case studies in the Rivers Danube, Rhine, Menindee and Holtemme as examples. A specific focus is given on endocrine disruption and mutagenicity. While natural and synthetic steroids were confirmed to play a key role for endocrine disruption, the fluorescent dye Coumarin 47 has been identified as a so far unknown environmental pollutant with great anti-androgenic potency in vitro and in vivo. In a water body with direct impact of industrial effluents individual aromatic amines probably from dye production could be identified as the drivers of mutagenicity. In contrast, mutagenic effects detectable in the River Rhine receiving multiple contaminations from many sources were driven by mixture effects of industrial and natural compounds with low individual potency but strong synergistic effects when occurring together.

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How to deal with mixtures of pollutants in water resource management?
R. Altenburger, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology, M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Chemicals in the aquatic environment do not occur in isolation but as mixtures. Their compositions, concentrations and effects are highly dynamic with regard to their temporal and spatial occurrence. Current approaches of the EU water framework directive for assessing chemical and ecological quality do not reflect the emerging challenges. The SOLUTIONS project (Brack et al. 2015, STOTEN 503:22) deconstructed the general challenge into three questions (i) How to identify priority mixtures, (ii) How to identify drivers of mixture risk, (iii) How to measure Effect. The presence of mixtures is a source of adult insects for recolonisation of the treated systems by a distance of 100 m and non-invasive monitoring of larvae and pupae. The test material was applied at a single rate on two occasions with a 14-day interval to ten microcosms containing predominantly egg rafts and post-overwintering fourth instar larvae of Chaoborus obscursus. Ten untreated microcosms with similar populations of Chaoborus were established upwind of the treated units and these, together with indigenous Chaoborus, served as a potential source of adult insects for re-colonisation of the treated units. Three microcosms in each group were covered with insect-proof netting to prevent natural re-colonisation in order to assess the extent of population recovery from within microcosms. The numbers and developmental stages of larvae along with the numbers of pupae and presence and numbers of egg rafts were monitored throughout the study using non-invasive methods, from the week before the first application in May 2017 to the end of August 2017. These assessment methods were successful in enumerating the larvae, pupae and extent of adult emergence over time. The findings from the study show that the early instar larvae of Chaoborus filtered out the least contaminants from the microcosms, the middle instars were impacted by contaminants, and that later instars were able to survive and pupate, and that adults emerge. Recolonisation was relevant to the ‘open-field’ given that the control microcosms were a substantial distance (100 m) from the treated microcosms. The results show that populations impacted by synthetic pyrethroids are re-established in less than 8 weeks after the first application.

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A mixture risk assessment for pollutants that reach humans via the water – fish exposure route
A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting

An important route for human exposures to substances present in freshwater is through the consumption of fish. To protect humans against this route of exposure, the WFD defines specific quality standards for priority substances. In general, combined exposures are not considered, with the exception of quality standards for mixtures of specific contaminant groups, such as polychlorinated dioxins (PCDD) or polychlorinated diphenyl ethers (PBDE). However, the possibility of combination effects across these pollutant groups is not currently considered. We present an advanced tiered mixture risk assessment for these groups of pollutants, first by using Water Framework Directive Quality Standards defined for PCDD and
PBDE in fish. We then make an attempt to expand the assessment by integration across these pollutant groups. While the definition of Quality Standards for specific pollutant groups is a step in the right direction, our analysis shows that more efforts are needed to protect humans from possible combination effects across pollutant groups. Such efforts are currently hampered by data gaps concerning common toxicities likely to arise in humans.

300 An Advanced Methodological Framework for the Identification of Priority Pollutants and Priority Mixtures of Pollutants in European Freshwaters

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We present a proposal for an advanced methodological framework for identifying priority pollutants and priority mixtures of pollutants in European freshwaters. The proposal was developed by the EU project SOLUTIONS. It aims to tackle major shortcomings of current prioritisation procedures under the EU Water Framework Directive (WFD). While high data demands were prioritised for further research, a conclusive risk assessment cannot be met. Significant risks from so-called emerging pollutants may remain undetected. The WFD does not include an effective mechanism to close such knowledge gaps. The introduction of a watch-list mechanism for up to 10 substances provided a minor improvement but no fundamental change to this situation. (ii) Individual pollutants are assessed as if they would occur in isolation, largely ignoring the fact that they are part of complex multi-constituent mixtures. Environmental quality standards that have been established for single priority pollutants may not be sufficiently protective against mixture effects. Regulatory approaches for effectively tackling the problem are missing. The advanced framework integrates all available lines of evidence (LOE) on significant risks. This includes evidence from (i) ecological monitoring (field observations on so-called biological quality elements), (ii) effect-based monitoring (in vitro or in vivo testing in the lab or onsite), (iii) chemical monitoring in combination with so-called component-based mixture risk assessment approaches, (iv) integrated modelling of co-exposure and resulting mixture risks. Where one or more lines of evidence identify groups of pollutants presenting a significant risk, there should be a prioritisation for risk reduction measures. Where appropriate, such groups may be reduced to few mixture components or even one single component which can be demonstrated to explain most of the overall risk, so-called drivers of mixture risks. Wherever conclusive evidence on significant risks and needs for risk reduction cannot be reached because all possible LOEs are somehow blocked by significant data or knowledge gaps, mixture components of potential importance would be prioritised for further research and testing. Some elements of the advanced methodological framework may be readily applicable under the existing WFD. Full implementation, however, requires changes in the legal text, as detailed in Brack et al. 2017 (Sci Total Environ 576:720-737).

301 A diagnostic toolbox for ecological effects of pollutant mixtures: a case study application using in situ experiments with microbial communities

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A toolbox for the detection of ecological impacts of chemicals was developed using a statistically supported, transparent and formalized weight of evidence (WOE) approach. It integrates four lines of evidence (LOE’s): (i) predictive mixture modelling, (ii) effect-directed analysis (EDA), (iii) in situ tests, and (iv) field-based monitoring studies. A systematic and quantitative method was developed for the aggregation of multiple in situ tests into LOE III, using an aggregated response index, which we termed the “average biomarker response” (ABR). The results of the four separate LOE’s are finally integrated using a systematic decision matrix that provides the main overarching conclusions that can be drawn from a given set of data and that pinpoint to critical data gaps. Here we first present an overview of the toolbox. Afterwards, we present a case study that used in situ experiments with phototoxicant biofilms (periphyton) in wastewater impacted streams. Chemical-analytical profiles initially showed clear differences of the micropollutant load in the water up- and downstream of the entry point of a sewage treatment plant effluent. These chemical-analytical data were evaluated for their potential ecotoxicological effects using toxicokinetic and toxicodynamic approaches. Based on outcomes of this LOE, we hypothesized that clear ecological effects on the structure and function of the exposed microbial communities should be present. Indeed, these were then confirmed using the concept of pollution-induced community tolerance (PICT). In the end, the study allowed us to demonstrate that (i) the STP effluent actually caused ecological impacts on the exposed microbial community (ii) a subsequent upgrade of the STP plant with activated carbon filtration led to a recovery of the community that was driven by a lowered overall toxic pressure, (iii) PSII inhibitors were the mixture toxicity drivers, and (iv) that ecologically relevant effects go beyond a mere toxic unit summation. The presented work was a joint effort of the EU funded project SOLUTIONS, the ERAfresh project that was funded by the Swiss Federal Office for the Environment, and the IMPROVE project, which is funded by the Swedish Research Council.

Derivation, Validation and Implementation of Environmental Quality Benchmarks

302 Questioning annual average concentrations for plant protection products - TKTD modelling of real exposure profiles

M. Junghans, Swiss Centre for Applied Ecotoxicology EAWAG - EPF / Ecotoxicology Centre; R. Kuhl, E. Zimmer, IBACON GmbH; I. Werner, Ecotoxic Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; R. Ashauer, University of York / Environment

The EU Water Framework Directive defines two environmental quality standards for assessing the chemical status of surface waters. The MAC-EQS defines the Maximal Allowable Concentration that should never be exceeded and the AA-EQS defines a concentration that should be exceeded by the Annual Average concentration. While the MAC-EQS should account for the acute toxicity of a substance, the AA-EQS is based on chronic ecotoxicity studies. For substances with highly fluctuating environmental concentrations like plant protection products the use of the annual average is disputed. Hence, in Switzerland it was suggested to use 14-day time-weighted average (TWA) concentrations for assessing compliance with quality standards for chronic toxicity. This approach is based on the average duration of chronic eco-toxicity tests and Haber’s rule. We assess the suitability of this approach for retrospective risk assessment by applying toxicokinetic-toxicodynamic (TKTD) modelling on high resolution exposure profiles of plant protection products measured in Swiss streams. The TKTD modelling is a proxy for the actual time-course of toxicity under time-variable exposure and is based on 7 species, 7 substances and 5 exposure profiles from 5 streams. The results confirm the suitability of the time integral of 14 days. The prediction of actual toxicity for the most toxic periods is very consistent with the toxicity modeled for the TWA. The deviations are on average less than factor 2 for each organism group tested. In addition to mortality for crustaceans and fish, only a small selection of sub-lethal effects was considered, namely reproduction and growth in water fowls and mortality growth in duckweed and algae. The results also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time-proportional 3-day mixed samples is inappropriate.

303 Revision of 62 Environmental Quality Standards - lessons learned

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Environmental Quality Standards (EQSs) are ecotoxicologically based threshold values that aim to prevent chronic effects of pollutants on ecosystems. Similar values exist in Switzerland and the Federal Office for the Environment recently commissioned the revision of existing EQSs for 62 substances to ensure that they are based on the current state of science. This study aimed to analyse the underlying reasons for numerical changes of EQSs and to highlight knowledge gaps. As for the original EQS derivation, relevant data were retrieved from databases, the public literatures and Toxicitation database, primarily provided by manufacturers. The reliability and relevance of ecotoxicological data were assessed using the CRED method. EQS derivation then largely followed the EU-Technical Guidance for Deriving EQS. After the revision, 60 AA-EQSs and 58 MAC-EQSs were proposed. The EQS revision did not generally lead to either lower or higher EQSs. AA-EQSs increased in 13 cases (max./median fold change +9.6/3) and decreased in 18 cases (60/9.6) while MAC-EQSs increased in 21 cases (50/6.18) and decreased in 9 cases (27.2/4). Most EQSs were derived deterministically, using the assessment factor (AF) method. Due to an increase in data for some
substances, the number of AA-EQs and MAC-EQs derived using Species Sensitivity Distributions (SSDs) increased from 2 to 5 and from 7 to 10, respectively. For AA-EQ derivation, AEs were reduced in 12 cases and increased in only 6 cases. For the MAC-EQ derivation, AEs were reduced in 5 cases and increased only in one case. Our study demonstrates that EQSs based on small data sets are more prone to large numerical changes when revised. Hence, an update often required when associated with the derived EQs, as evident from application of lower AEs and more frequent EQs derivations based on SSDs. This is likely to make EQSs more robust against larger changes in future revisions. Nevertheless, for the majority of the substances considered in this study, data sets were insufficient to construct SSDs. This is mostly due to a lack of studies using non-standard test species and species from important taxonomic groups, such as amphibians or insects, and may bias the evaluation of ED effects of a substance, this factor alone prevented the use of lower AEs. Finally, recommendations regarding assessability and quality of ecotoxicity data from industry studies and from the scientific literature are presented.

304 Endocrine disrupting properties: how far and consistent they are considered deriving Water Framework Directive Environmental Quality Standards? A case study tackling French and EU EQS values

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The current status of endocrine disrupting properties (ED) is quoted several times as an issue for deriving water quality thresholds in the European Commission Technical Guidance for Deriving Environmental Quality Standards (TGD EQS). However, even if this guidance introduces ED properties as a reason for growing concern, it does not properly recommend any specific methodological approach to consider these properties while deriving EQS values. In order to evaluate the usefulness of such a recommendation and the extent to which it should be implemented, a state of the art introduction of the methods employed by jurisdictions around the world, the specific properties where reported and taken on board if necessary for protection of wildlife and non target species is presented. For the current state of the art, ED properties are currently taken into account in derived EQS values in France, Ireland, Italy, Spain, UK, and a significant number of other European countries. These countries have developed EQS values for ED properties as regards ED potential in substances whose EQS values do not consider ED effects, and which need to be reassessed as a matter of priority. Substances for which EQS derivation has considered ED effects but whose rationale does not clearly explain this are grouped together in Group 2 and should be verified. Group 3 corresponds to substances whose ED characteristics have been considered as additional safety factors and / or ED properties have been previously taken into account. Group 4 contains all chemicals where no ED effects demonstrated from now on. No action is required for these last two categories. This state of play and categorisation work made it possible to prioritise substances for which EQS should be updated first as regards their ED potential. Also, this work gives more insight on how to derive EQSs as regards ED potential in order to further propose recommendations for a harmonisation of the methodology in the future.

305 Bringing water quality benchmark derivation approaches into the 21st century


The most common method for deriving water quality benchmarks (WQBs) is the use of a species sensitivity distribution (SSD) to estimate a concentration that is protective of x% of species. Although various methods exist in the specifics of the methods employed by jurisdictions around the world, the fundamental SSD approach is similar and, moreover, has not changed markedly over the past 20 years, despite a significant body of published research aimed at improving or developing new derivation methods. The recent revision of the Australian and New Zealand SSD-based derivation method has re-highlighted numerous limitations of the SSD approach for certain data situations and toxicant types; for example, small sample sizes, model choice and fit, and accommodating different routes of exposure (e.g. for persistent, bioaccumulative and toxic compounds) and specific mechanisms of toxicity (i.e. bimodality). However, areas for improvement of WQB derivation methods extend beyond just refining SSD-based approaches, to the use of non-SSD approaches and weight of evidence approaches that give consideration to both laboratory- and field-effects data. Other opportunities for improvement exist in the acquisition of data for WQBs (e.g. type and acceptability of toxicity data), as well as the application of WQBs in water quality management. Thus, it is important to identify and target the limitations that, if addressed, will yield the biggest benefits to environmental protection. Experience has shown that a ‘one size fits all’ approach to WQB derivation does not work, and an alternative is to provide flexibility and adopt approaches that do the best job in the face of the specific conditions and uncertainty posed by different situations. However, this may increase the complexity of the derivation process and, thus decrease understanding and adoption by users. This presentation will examine a variety of questions associated with WQB derivation and the mechanisms and types of research efforts that have been undertaken to significantly evolve the way we derive WQBs? To what extent have the outcomes of this research been adopted in formal derivation methods? Why has the fundamental SSD approach not changed markedly over the past 20 years despite various proposed improvements? Do we need to move to a new generation of WQB derivation approaches and, if so, what are the aspects that will have the biggest impact, and the criteria that would make new approaches amenable for adoption?

306 The quest for consistent environmental protection: the challenge of variable water quality guidelines between regulatory jurisdictions

G. Merrington, A. Peters, wca; S. Kosmala, WCA Environment Limited

One of the tools used by regulatory jurisdictions to deliver environmental protection is Water Quality Guidelines (WQGs) or Environmental Quality Standards. These are thresholds expressed as a chemical concentration, with an associated summary statistic (e.g. maximum) and period (e.g. “annual average”). These thresholds are used around the world for a number of purposes including to assess and protect water quality in drinking water and the environment and to set effluent discharge permits. Historically, most regulatory jurisdictions across the globe have, at the very least, WQGs for some trace elements. The perceived challenge for many in the regulated community, especially multinational organisations, is the lack of transparency in derivation and implementation of WQG within a regulatory jurisdiction and the inconsistent environmental protection levels between regulatory jurisdictions, despite having the same protection goals. Here we will address the veracity of that perception and attempt to understand its source. There is limited consistency in environmental protection, as judged by WQG for the same trace element, across regulatory jurisdictions. The absence of robust protocols (or any protocols that can be reviewed) for the derivation of the derivation is a major factor as is the inevitable lack of resources and time for many regulators to update WQG and account for new scientific developments. There are unfortunate repetitive cycles of derivation that each jurisdiction goes through for the same substances and perhaps there is benefit in sharing knowledge and understanding across jurisdictions that would deliver consistent and transparent levels of environmental protection.

307 A Call for Greater International Collaboration in Developing Environmental Quality Benchmarks: Many Hands Make Lighter Work!

M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science; G. Merrington, wca

Environmental quality benchmarks (EQBs), also variously called guidelines, standards, criteria) are an internationally accepted means of protecting ecosystems from the adverse effects of toxicants. As such, numerous countries, states/provinces, regions, academics and consultants have developed EQBs. As a result there are numerous EQBs for the same suite of chemicals (e.g. copper, lead, benzene), each slightly different. This is a huge waste of resources. These differences arise because of the differences in the methods used to derive the EQBs, which govern what is considered acute and chronic, what data can be used, and the magnitude of assessment factors etc. The current situation with the derivation of EQBs has been compared to that of toothbrushes – “everyone has one and no-one else wants to use anyone else’s” and disagreements arise about whose “toothbrush” is the best, whether particular features are “arbitrary” etc. We believe that such nonesserians, is the lack of transparency in derivation and implementation of WQG within a regulatory jurisdiction and the inconsistent environmental protection levels between regulatory jurisdictions, despite having the same protection goals. Here we will address the veracity of that perception and attempt to understand its source. There is limited consistency in environmental protection, as judged by WQG for the same trace element, across regulatory jurisdictions. The absence of robust protocols (or any protocols that can be reviewed) for the derivation of the derivation is a major factor as is the inevitable lack of resources and time for many regulators to update WQG and account for new scientific developments. There are unfortunate repetitive cycles of derivation that each jurisdiction goes through for the same substances and perhaps there is benefit in sharing knowledge and understanding across jurisdictions that would deliver consistent and transparent levels of environmental protection.

SETAC Europe 28th Annual Meeting Abstract Book
Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring

308 The impact of anthropogenic activities on bacterial and viral diversity in the Eastern Mediterranean Sea
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The Eastern Mediterranean Sea is a low-nutrient low-chlorophyll marine ecosystem [1] but some variability within the basin does exist. Indeed, several coasts are influenced by anthropogenic processes, and specifically in the Greek coasts these include industrial, harbor, agriculture, mariculture activities, urbanization and tourism [2]. Our hypothesis was that prokaryotic and viral community diversity is differently affected in contrasting coastal systems by anthropogenic pressures. We used 16S rRNA gene amplicon and whole virome sequencing at stations characterized by different chemical features based on the “National monitoring project for the implementation the Water Framework Directive (2000/60/EE) in Greece” [2]. We focused on viral auxiliary metabolic genes and the influence of heavy metals (Cu, Cd, Co, Ni, Pb, Zn, Cr and Hg). Significant differences were found at the genus level between the sampling stations. Proteobacteria were dominant in all sites, while Bacteroidetes were more pronounced in some of the stations. Rare phyla were higher in Echinades and Patraiko Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, Cd, Cu and Pb. The highest concentrations of NO\textsubscript{2}, NO\textsubscript{3}, NH\textsubscript{4}, PO\textsubscript{4}, SiO\textsubscript{2} and chlorophyll a were found in stations influenced by extensive industrial, agricultural and maricultural activities. The 3 stations of Anvrakikos Gulf were highly variable in terms of community structure. Significantly lower relative abundance of Verrucomicrobia and Bacteroidetes in the “control” than in the “impact” station in Kefalonia (inside and outside the influence of the fish farms, respectively) was seen. Bacterial 16S rRNA analysis revealed significant differences between stations along the Greek coast, suggesting that each station hosts a different community. Analysis of viral metagenomes will show if community composition reflects the anthropogenic activities in these areas, and if lysogenic (i.e. viral integrase and auxiliary metabolic genes’ abundance) is a prevalent life strategy. [1] Krom MD, Emeis K-C, Van Cappellen P. 2010. Why is the Eastern Mediterranean phosphorus limited?. Prog Oceanogr 85:234-244. [2] Pavlidou A, Simboula N, Rousselaki E, Tsapakis M, Pagou K, Drakopoulou P, Assimakopoulou G, Kontoyiannis H, Panayotidis P. 2015. Methods of eutrophication assessment in the context of the water framework directive. Cont Shelf Res. 108: 156-168.

309 Impacts of stormwater on microbial community structure and function in estuarine sediments
K. Haffouf, Macquarie University / Evolution and Ecology Research Centre; P. Steinberg, University of New South Wales / Centre of Marine Biotechnology; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; J. Potts, P. Scanes, NSW Office of Environment and Heritage; S.C. Birrer, University of New South Wales; M. Sutherland, NSW Office of Environment and Heritage; V.X. Sim, University of New South Wales; T. Lachnit, University of Kiel; S. Swanup, National University of Singapore; S. Kjelleberg, Nanyang Technological University / The Singapore Centre on Environmental Life Sciences Engineering; M. Doblin, Department of Environmental Sciences / Department of Environmental Sciences; G. Birch, Sydney University / School of Geosciences; P. Gribben, University of New South Wales; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre. Estuaries are diverse and productive ecosystems that are subject to high levels of disturbance. They are exposed to multiple stressors such as legacy contaminants in sediments and ongoing inputs of nutrients and metals via stormwater, but we still have little understanding of the consequences for ecosystem functioning. We surveyed sediment communities at four locations with large stormwater drains in Sydney Harbour, Australia. Locations were either poorly-flushed embayments or well-flushed channel heads. Sediments were collected monthly during base rainfall (<5mm/day) for 4 months from 3 sites within each location at increasing distance from the stormwater drain (0, 200 and 1000 m). We also collected sediments after 2 large rain events (>150mm in 24h). Next-generation sequencing was used to characterize the microbial community and sediment was subsampled for metals, total organic carbon, total nitrogen and phosphate. Sediment cores were also collected to assess chemical processes including primary productivity, community respiration and nutrient cycling. We observed major shifts in the microbial community related to exposure to legacy contaminants and new stormwater contaminant inputs. We also found trends of decreasing community respiration rates away from storm drains and lowest rates of primary production during base rainfall. The results have implications for future management of stormwater in estuaries and increase our understanding of how to conserve crucial sediment community diversity and function.

310 Drought as environmental driver on ciliates and micrometazoa communities in a multistressors scenario. An experimental approach
J. López-Doval, F. Romero, V. Acuña, S. Sabater, ICRA Catalan Institute for Water Research

Climate change will affect agriculture practices and productivity because increased irrigation will be necessary to meet high water demands and changes in phenology, that means a future increase in the use of pesticides and, in consequence higher risk of freshwater pollution. In addition climate change will lead to higher severity of drought events and higher temperatures. Ciliates and micrometazoans in freshwater ecosystems play an important role in the processing of organic matter and as basal resource for consumer organisms. The present work aims to study how these environmental and chemical stressors, and their interactions, in a future scenario of climate change can affect these communities in freshwater sediments. To study how drought (D), warming (T) and a realistic environmental mixture of pesticides (P) can affect the communities of ciliates and micrometazoa in river sediments, we developed an experiment with a factorial design in experimental indoor channels with natural sediment from a pristine river (24 channels, 3 replicates, 3 experimental conditions). The community was exposed to the stressors for 7 weeks. Diversity of Ciliophora and micrometazoa communities was studied twice during the experiment (one week before and after 7 weeks of chronic exposure). Significant changes in community composition between pre- and post- exposure were observed for all treatments. Community was dominated by micrometazoa in all treatments in terms of density, but a trend of increasing the percentage of ciliates in these treatments with stressors was observed, indicating a possible advantage of ciliates in stressed environments. At the end of the experiment total density was significantly higher respect to control in D, DP and TDP treatments (p < 0.001 Dunnet’s test) while diversity was significantly higher in D, TD and TP conditions (p < 0.001 Dunnet’s test). Taking into account the community structure, the most relevant factor causing significant differences in community composition (PERMANOVA p< 0.001). The mixture of pesticides at realistic environmental concentrations did not cause any effect on the studied communities. Our results suggest that flow reduction is the main driver for changes in micrometazoa and ciliate communities in our experimental system while pesticides and temperature produce significant effects only in combination with drought.

311 Linking pesticide pollution with periphyton quality in agricultural streams: a fatty acids approach
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Although the environmental risks associated with pesticide pollution in agricultural streams are quite well documented, little is known about its potential effects on periphyton quality. Periphyton provides many of the essential polynsaturated fatty acids (PUFA) that are needed for organisms at higher trophic levels in river food webs. This study aims to assess the effects of pesticide mixtures on periphyton quality in situ. Three streams (Höje å, Skivarpsån and M42) located in the agriculturally dominated region of Skåne (SE Sweden) were sampled in September and October 2016. The effects of pesticide pollution were assessed by passive field sampling coupled with laboratory ecotoxicity tests, by mixture toxicity modelling to predict which chemical stressors were potentially driving the toxicity, and by examining the fatty acid profiles, pigment content and algal diversity of periphyton communities. Results from water chemical analyses clearly showed higher levels of nutrients and pesticide pollution in Skivarpsån and M42 than in Höje å. Ecotoxicity tests using the passive sampler extracts demonstrated that the pesticide mixture occurring at Skivarpsån and M42 were toxic for periphyton communities from Höje å, causing an inhibition of the photosynthetic activity up to 63% and 53%, respectively. Cluster and principal component analyses based on pigments content, algal diversity and fatty acid profiles, clearly separated the periphyton from the three river sites studied. Algal biomass from periphyton of pesticide polluted streams (Skivarpsån and M42) was higher than in Höje å. The nutritive quality of the periphyton differed among streams, and fatty acids considered important for health, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were also more abundant in pesticide polluted streams (Skivarpsån and M42). Overall, even though results from the lab show that the mixture of pesticide pollution in the studied...

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Improvements compared to datasets for tailings disposal from a range of ore types, which will contribute to worldwide, the model was used to develop new country primary metals in LCA studies. Here, we present an extended mixture thus preventing accumulation in soil and subsequent contamination of ground water.

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Estrone and triocloro mixtures alter soil metagenomics during degradation D.L. Carr, Texas Tech University / Biological Sciences; E. Osugi, Texas Tech University / Biological Science

Wastewater derived from domestic use commonly contains mixture of pharmaceutical and personal product (PPCP), but its persistence and accumulation in the soil and the consequences for soil microbial community processes are poorly understood. Estrone and triocloro are two common PPCPs of domestic wastewater. Soil microbial communities degrade a variety of PPCPs however; most studies have only addressed single compound designs neglecting the reality of their co-occurrence in nature. In this study, we examined the interaction between estrone and triocloro mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrone, triocloro, and a 1:1 mixture of estrone: triocloro, and incubated for 90 days in the dark at 27°C. We examined soil microbial function dynamics using commercial Biolog EcoPlates™. Microbial degradation rates were compared over the 90 days’ incubation period using high performance liquid chromatography. Metagenomic analysis by 16S rRNA was used to determine changes in microbial community over time. There was significant increase in substrate activity and substrate richness in all treatments. Each microbial community utilized different carbon substrates by day 90 whereas they had exhibited similar substrate utilization at day 0. Estrone and triocloro as single compound treatments exhibited half-lives of 6.8 days (estrone) and 26.7 days (triocloro). The rate of degradation of the binary estrone:triocloro mixture was the same as the individual compounds. There was a decrease in species diversity between control at day 0 and all other treatments at day 90 with establishment of unique OTUs in each treatment group at day 90. Metagenomic analyses indicate distinct communities by treatment 90 days after exposure even though Bacillus sp. was dominant in all the day 90 treatments. Soil microbial communities are adept at degrading estrone and triocloro in this soil whether occurring singly or as a binary mixture thus preventing accumulation in soil and subsequent contamination of ground water.

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Poster spotlight: TU014, TU015, TU016

Integrating life cycle approaches towards a sustainable circular economy (II)

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Region-specific life cycle inventories for tailings disposal in ecoinvent v3 D.A. Turner, EMPA / Technology and Society Lab; G. Doka, Doka Life Cycle Assessments; A. Haarman, EMPA Technology & Society Lab / Technology & Society Lab; R. Hirschier, EMPA / Technology and Society Lab

Tailings, a waste material produced during mineral concentration (beneficiation), often contain significant quantities of mobile toxic metals and are typically produced in large quantities. To manage these wastes, tailings are commonly stored behind dams impoundments, known as “tailings ponds”. These ponds pose a significant long-term pollution risk as metals may leach out into the surrounding environment, potentially over very long timeframes. The management of tailings therefore represents an important environmental burden for primary metal production. To help life cycle assessment (LCA) practitioners quantify this important environmental burden, the ecoinvent database contains specific inventories for tailing disposal in ecoinvent v3. However, the dataset was intended only to serve as a first generic estimate and is based on highly aggregated data that attributes an identical burden to each kilogram of waste, regardless of its composition. Given their relevance to the overall impacts of primary metals production, access to more detailed, region-specific LCI data on tailings disposal is crucial for a more comprehensive and adequate integration of primary metals in LCA studies. Here, we present an extended model for assessing the long-term emissions from tailings disposal. The model can heed a specific tailings composition and local climate data, allowing for the creation of site- and region-specific LCI data based on an extensive literature survey. The data on tailings compositions and leachate concentrations from different mine sites worldwide, the model was used to develop new country- and region-specific datasets for tailings disposal from a range of ore types, which will contribute to improving the quality and hence reducing uncertainties in LCA studies worldwide. Our presentation will give an overview of the extended model and related datasets, which will be integrated in a later version of ecoinvent. We will also highlight its improvements compared to the previous model by presenting the results of an LCA case study of region-specific primary metals production in order to demonstrate the important differences between global average and situation-specific calculations in such an important sector as primary metals production.

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Closing the copper cycle in the EU-28: scenario analysis and potentials for GHG emissions reduction L. Ciacci, Alma Mater Studiorum - University of Bologna; F. Passarini, Alma Mater Studiorum - University of Bologna / Dept. of Industrial Chemistry

Copper is widely used in modern society, finding application in traditional end-uses such as plumbing, infrastructure, and transportation, but it is also an essential material in emerging green energy technologies. Europe (i.e., EU-28) has modest natural deposits and strongly depends on imports to meet the domestic demand. In the absence of end-of-life recycling and possible supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, as copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling economic cycle. Scenario analysis making problems and associated is its ongoing design and less operation. The examined networks comprise multi-economies, including disposal markets, collection facilities, recycling plants and reuse markets connected by a transportation mode. The system is modelled as a multi-objective mixed-integer linear programming (MILP) optimisation problem allowing the inherent trade-offs between the conflicting economic and environmental objectives to be explored. The economic function is not economic indicator calculated to evaluate the total cost the resulting energy savings and greenhouse gas emissions reduction. The results show that copper recycling can contribute significantly to reduce the energy requirements and mitigate greenhouse gas emissions associated with the regional copper industry. However, for three out of the four scenarios the current recycling performance seems not to be enough to close the copper cycle. Fundamental constraints are likely to limit the implementation of a circular economy unless dramatic changes occur in the current pattern of copper production, consumption and recycling at end-of-life.

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Multi-Objective Reverse Supply Chain Network Design of Fluorescent Lamps with Piecewise Linear Functions C. Leg, L. Papageorgiou, University College London / Department of Chemical Engineering; N. Shah, Imperial College London / Department of Chemical Engineering

In this reverse supply chain model has been developed to support strategic decisions making problems and associated with the recycling network design and less operation. The examined networks comprise multi-economies, including disposal markets, collection facilities, recycling plants and reuse markets connected by a transportation mode. The system is modelled as a multi-objective mixed-integer linear programming (MILP) optimisation problem allowing the inherent trade-offs between the conflicting economic and environmental objectives to be explored. The economic function is not economic indicator calculated to evaluate the total cost the resulting energy savings and greenhouse gas emissions reduction. The results show that copper recycling can contribute significantly to reduce the energy requirements and mitigate greenhouse gas emissions associated with the regional copper industry. However, for three out of the four scenarios the current recycling performance seems not to be enough to close the copper cycle. Fundamental constraints are likely to limit the implementation of a circular economy unless dramatic changes occur in the current pattern of copper production, consumption and recycling at end-of-life.

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The use of Life Cycle Assessment to adjust consumption taxes: The concept of a Damage and Value Added Tax B. Timmermans, Université Libre de Bruxelles; W. Achten, Université Libre de Bruxelles / Department Geosciences, Environment and Society

The purpose of this presentation is to provide a short insight about a study examining the principles and feasibility of a shift from Value Added Tax (VAT) or sales tax to a Damage and Value Added Tax (DaVAT) partially based on the life cycle assessment of products and services. With this shift, goods and services that seriously harm the environment and human health will be priced up, those that have less impact will be priced down. The DaVAT system relies on three essential
points: i) Apply VAT (or consumption taxes in general) to all goods and services and reduce its multiple rates to one single low rate (e.g. 3%) called Uniform VAT (UVAT); ii) Add to UVAT a per-unit tax called Global Damage Tax (GDT) calculated on the basis of environmental impacts assessed by means of specific or generic LCAs. In the case of potentially high-polluting products or industries, a specific LCA will be automatically imposed; iii) In order to reflect environmental, social or health-related cost specific to a country, a so-called Specific Damage Tax (SDT) is proposed that extends beyond LCA. DaVAT is the sum of UVAT, GDT and SDT. DaVAT is conceived not as an additional burden but rather as a shift of taxation, as the rate of the old consumption taxes can decrease proportionally to the increase of GDT. DaVAT is also designed in such a way that the erosion of tax revenues, when pollutant releases would decline, is offset by the extension of the tax to all goods and services and by the possibility to gradually re-increase the VAT rate when the number of highly-polluting products decreases. To reduce the variance of the LCA results used for this purpose, the DaVAT system should use common databases, apply the same inventory, characterization, normalization and weighting methods, as well as refer to the same impact categories and the same cut-off rules. LCA as a whole can stay as it is, but for use in DaVAT specific impact categories (e.g. climate change, human health assessment based on previous studies has been made of the costs of implementation, maintenance, administration and compliance of DaVAT, as well as of the risks of fraud, price changes and acceptability of the proposal. The presentation shall briefly outline the results of this assessment.

318 Towards global guidance on LCA of mineral resource use - outcomes from the UN Environment Life Cycle Initiative task force T. Sondergerg, ETH Zurich; M. Berger, Technische Universität Berlin / Chair of Sustainable Engineering - Office Z1; R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Bach, Technische Universität Berlin / Chair of Sustainable Engineering; A. Cimprich, University of Waterloo; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; R. Frischknecht, treeze Ltd.; J. Guinee, University of Leiden / Institute of Environmental Sciences; C. Heßwig, University of Augsburg; O. Jolliet, University of Michigan; M. MOTOSHIKA, National Institute of Advanced Industrial Sci. and. S. Northey, Monash University; D. Schrijvers, Technische Universität Berlin / Chair of Sustainable Engineering; A. Cimprich, University of Waterloo; J. 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Finally, we will highlight priority hazardous chemicals for substitution. Using Classification, Labeling and Packaging (CLP) data on hazard classifications, we show that chemicals used in plastics manufacturing, such as solvents and raw materials, and the main components of DWR treatments are released to the environment, and we will discuss the research needed to allow for a more robust hazard characterization and ranking.

Emissions of PFASs and alternatives from the durable water repellence layer (DWR) of textiles during use

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In the durable water repellence (DWR) layer of textiles of outdoor clothing, PFASs have been used because their perfluoralkyl chains have the ability to repel liquids of a wide range of polarities (DWR, hydrophobic and hydrophilic), and DWR compounds, like PFASs and silicones, are emitted to air. We study the emissions using different emission scenarios which are based on real-life situations such as leaching to rain water, emission to air, weathering and tumbling. Within the SUPPES project different types of formulations, PFAS-based as well as silicon-based, have been applied to two different types of textiles, i.e. polyamide (PA) and polyester (PES). After testing the water repellence properties, a selection of four PFAS-based textiles and three silicon-based textiles have been used for assessing the emission of PFASs and silicones. For chemical alternative assessments it is highly important to include proper application tests in combination with experimental emission exposure scenarios. This information will provide valuable information to aid selection of safer alternatives. The emissions of chemicals out of the DWR-treated textiles are not only depending on the type of DWR, but also on the type of textile used. Weather conditions, like sunlight, high temperature, or humidity can have a strong effect on the emission of chemicals for the entire service life of the textile. We suggest that it is necessary to develop a procedure for the application of environmentally harmless DWR chemicals.

Chemicals in plastic packaging: Prioritization of hazardous substances

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Plastic packaging is increasingly used globally, causing raising concerns for the environment and human health from littering, release of microplastic and leakage of hazardous chemicals. Specifically, chemicals may migrate into foods or the environment during use, disposal, and recycling of the packaging material. Occupational exposure during plastic packaging manufacture is also relevant. One of the main obstacles to assessing the risks of chemicals originating from plastic packaging is the absence of information on the materials’ exact chemical composition. In order to provide an overview of the chemicals associated with plastic packaging, we compiled the Chemicals in Plastic Packaging Database (CPP-DB), which comprises unique substances with additional substance-specific information such as purity, data, physico-chemical properties and uses. The CPP-DB includes plastic monomers, additives, and other substances used during plastics manufacturing, such as solvents and raw materials, and the main non-intentionally added substances (NIAS) such as impurities, reaction by-products or degradation products of e.g. polymers and stabilizers. We ranked the substances in the CPP-DB according to their hazard for human health and the environment, using Classification and Packaging Category and hazard category. Finally, we will discuss the research needed to allow for a more robust hazard characterization and ranking.

A Safe by Design framework to support the development of sustainable nano-enabled products for the restoration of works of art

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Innovative nano-enabled products can overcome some of the traditional restoration techniques, especially in the case of complex and unstable materials used in contemporary artworks. However, nanomaterials have been demonstrated to be potentially hazardous to both humans and the environment. Thus, their application for the conservation of cultural heritage requires a proper assessment and management of potential risks. A Safe by Design (SbD) approach can support the early identification and management of uncertainties and risks during an innovation process and allows for the modification of a product design to avoid undesired properties. Within the EU H2020 “NANORESTART” project, a stepwise SbD framework for the sustainability assessment of nano-based products for restoration has been proposed, taking into account the current EU legislative context as well as the specific features of the innovation process in the restoration field. The proposed framework embraces the SbD concept proposed by NANOREG initiative, which uses the Cooper Stage Gate innovation model as backbone to incorporate SbD in structured innovation management processes for nanomaterials. Six steps build up the framework: (a) state-of-the-art assessment, (b) initial formulation, (c) screening hazard assessment (based on CLP self-classification approach for mixtures), (d) advanced hazard assessment (based on the development of an Intelligent Testing Strategy (ITS)), (e) safety assessment (including the definition of Risk Management Measures), and (f) sustainability assessment (where environmental, social, economic and technical criteria are integrated to compare new to conventional products). The framework is focused on application and post-application stages, while the manufacturing stage cannot be included until the industrial up-scale has been finalized. The SbD framework is currently being applied to NANORESTART advanced nano-based formulations for controlled cleaning and surface protection and consolidation. A specific ITS has been defined, including three biocidal, three photocatalytic toxicological, and aquatic toxicity, (iii) a set of tests for cytotoxicity, DNA-damage and mutagenicity. Moreover, specific leaching test protocols are being applied to investigate medium and long-term behaviour of products in post-application stages. The results of the framework application to the most promising formulations will be presented and discussed in detail.

Managing on the Margins: The confluence of Modern Agriculture and Aiculture

Z. Browning, Brownings Honey Co., Inc.

In the USA, beekeeping is a hobby, a sideline business, and commercial enterprise. Pollinating our backyard gardens, and local communities is made possible by backyard beekeepers with one hive or more. Beekeepers who aspire to increase their honey production, and crop pollination may have hundreds of hives serving not just their local communities, but their state or regions of the country renting their hives to pollinate specialty crops. Commercial beekeepers migrate with their tens of thousands of colonies to pollinate the nation’s food supply. Once commercial bee colonies have polluted the majority of specialty crops they head to summer forage areas for a honey crop. The areas of conflict for bees in agriculture extend from the urban to the rural landscape. The potential to pollinate the nation’s food supply is under threat as the nation’s food production and protection of human and animal health from disease vectors must be coordinated to ensure profitable production outputs for all stakeholders. Beekeepers can assist in the development of...
scientifically supported risk assessment through participation in research development. Beekeepers know bees; researchers know research protocols. To understand how honey bees function under migratory beekeeping and crop field conditions beekeepers need to be part of designing the risk assessment research. Beekeepers, no matter the level of beekeeping or number of hives, are eager to be included in research that will help alleviate the risks to honey bees, and native pollinators. Involving beekeepers in risk assessment and research design is key to ensuring the research process and results truly reflect the real-world of beekeepers and honey bees. In some ideal world beekeepers would be respected for the ecosystem service their honey bees provide to farmers. Beekeeper and farmer would understand their symbiosis in connection with the health of the crop, and the success of the crop’s yield. Both would work to ensure a healthy crop and healthy honey bee colonies in all crops. One begets the other; each supporting each other: beekeeper and farmer, honey bee and crop (personal examples). As such all stakeholders who rely on honey bees and native pollinators to maintain a healthy ecosystem would balance competing interests to ensure pollinators have clean, plentiful, and diverse forage, pollinators are healthy to provide appropriate pollination services to the ecosystem, and land management is facilitated to reduce soil erosion, protect water, and reduce the threat of disease vectors. (share Bee and Butterfly Fund programs as results)

327 A new multi-dimensional method for evidence synthesis and weighting in bee risk assessment

A. S. Dorigo, R. Sharp, C. Szentes, D. Auteri, EFSA - European Food Safety Authority / Pesticides Unit

In recent years, neonicotinoids substances have often been in the spotlight, particularly due to their effects on bees. Reporting of highly contradictory results catalysed much attention from the scientific community. The great amount of available studies requests approaches able to ensure an effective integration of the available data. To this purpose, EFSA has developed a novel approach for the most recent conclusions on imidacloprid, clothianidin, and thiamethoxam. Risk due to exposure of bees from residues in pollen and nectar of treated crops is used here as a case study to illustrate the methodology. Oral exposure was estimated by combining data on residue levels in pollen and nectar and estimation of bee food consumption. Together with exposure data, higher tier effect data were the core of the weight of evidence exercise. Each endpoint was identified by four dimensions: (I) the magnitude of the observed deviation from the control, (II) the reliability, (III) the level of exposure in the experiment, and (IV) the length of the exposure. In order to visually illustrate these four dimensions of the endpoints and in order to help the interpretation of each ‘line of evidence’, a tailored graphical representation was developed. The relevance of each line of evidence was established a priori, based on the relationship with the specific protection goals (SPGs). Integration of the lines of evidence followed a stepwise procedure, giving priority to the higher classes of relevance. Single risk assessment results are beyond the scope of this platform, which aims at communicating the features of this new approach. This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific topic. The exercise combined systematic reviews and weight or evidence, sharing many aspects with meta-analysis techniques. The approach used in this assessment addressed some issues that commonly undermine the reliability of meta-analysis such as the so-called ‘file-drawer’ problem. Overall, the presented approach ensured significantly more transparency than a fully qualitative expert judgment-driven assessment, but still allowed considering several dimensions in a qualitative approach and preshrinking the assessment by using fully quantitative measurements that, at present stage, are hardly capable of retaining important qualitative information.

328 PESTICIDE EXPOSURE ASSESSMENT PARADIGM FOR BUMBLE BEES

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A new multi-dimensional method for evidence synthesis and weighting in bee risk assessment. Risk due to exposure of bees from residues in pollen and nectar of treated crops is used here as a case study to illustrate the methodology. Oral exposure was estimated by combining data on residue levels in pollen and nectar and estimation of bee food consumption. Together with exposure data, higher tier effect data were the core of the weight of evidence exercise. Each endpoint was identified by four dimensions: (I) the magnitude of the observed deviation from the control, (II) the reliability, (III) the level of exposure in the experiment, and (IV) the length of the exposure. In order to visually illustrate these four dimensions of the endpoints and in order to help the interpretation of each ‘line of evidence’, a tailored graphical representation was developed. The relevance of each line of evidence was established a priori, based on the relationship with the specific protection goals (SPGs). Integration of the lines of evidence followed a stepwise procedure, giving priority to the higher classes of relevance. Single risk assessment results are beyond the scope of this platform, which aims at communicating the features of this new approach. This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific topic. The exercise combined systematic reviews and weight or evidence, sharing many aspects with meta-analysis techniques. The approach used in this assessment addressed some issues that commonly undermine the reliability of meta-analysis such as the so-called ‘file-drawer’ problem. Overall, the presented approach ensured significantly more transparency than a fully qualitative expert judgment-driven assessment, but still allowed considering several dimensions in a qualitative approach and preshrinking the assessment by using fully quantitative measurements that, at present stage, are hardly capable of retaining important qualitative information.

330 Standardization of an in vitro larval rearing method for stingless bee species Melipona scutellaris for use in toxicological bioassay studies

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Brazilian beekeepers have collected pollen and nectar contaminated and, subsequently, to offer the resources to the brood. Studies on larval phase focus on Apis mellifera, since for this species the rearing method is already standardized by the OECD®. However, while in A. mellifera the larval food is progressively offered to the brood, in stingless bees the food consists of mass feeding. This scenario requires the development of techniques which enable to evaluate the exposure of native bees during larval phase to pesticides, and may be used for public authorities responsible for environmental safety for studies on risk assessments. Melipona scutellaris is an interesting species to be used as a model organism for risk assessment, since, besides composing the native Brazilian fauna, species from the same genus are recognized as effective pollinator of important crops as eggplant, tomato and sweet pepper. Thus, the present study aimed to propose an in vitro larval rearing method of M. scutellaris. We extracted the larval food from 20 brood cells per non-parental colony (n =3), for estimating the amount of food consumed by larvae. Before the experiments, the acrylic plates where the food cells were placed in the Petri dishes was reduced to 75%, adding NaCl This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific species. In its present over-conservative form, the EFSA guidance will make it difficult to register any new or existing insecticide, as well as many herbicides and fungicides. Industry believes that further work and significant revision are required to build a pragmatic, applicable and consistent guidance document within the regulatory framework and has invested much time and money in developing a practical alternative based on the same science.

339 Industry research and approaches to improve the bee risk assessment scheme in Europe

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The Crop Protection industry recognizes the need to review the bee pollinator risk assessment based on scientific progress. However, the draft EFSA Bee Guidance Document is not a realistically feasible way forward. It is based on extremely conservative assumptions, its study requirements lack clarity and are not workable and guidelines for a number of studies are unavailable or not validated. Industry therefore believes that a revision of the assessment scheme for use by regulatory authorities is needed. Building on an analysis of the proposed developments in the EFSA Bee Guidance Document, we suggest proactive and practical approaches based on analysis of existing data generated thus far on honeybees Using the existing laboratory chronic risk assessment model for non-Apis bees as a case study to illustrate the methodology. Oral exposure was estimated by combining data on residue levels in pollen and nectar and estimation of bee food consumption. Together with exposure data, higher tier effect data were the core of the weight of evidence exercise. Each endpoint was identified by four dimensions: (I) the magnitude of the observed deviation from the control, (II) the reliability, (III) the level of exposure in the experiment, and (IV) the length of the exposure. In order to visually illustrate these four dimensions of the endpoints and in order to help the interpretation of each ‘line of evidence’, a tailored graphical representation was developed. The relevance of each line of evidence was established a priori, based on the relationship with the specific protection goals (SPGs). Integration of the lines of evidence followed a stepwise procedure, giving priority to the higher classes of relevance. Single risk assessment results are beyond the scope of this platform, which aims at communicating the features of this new approach. This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific species. In its present over-conservative form, the EFSA guidance will make it difficult to register any new or existing insecticide, as well as many herbicides and fungicides. Industry believes that further work and significant revision are required to build a pragmatic, applicable and consistent guidance document within the regulatory framework and has invested much time and money in developing a practical alternative based on the same science.
Understanding human and environmental exposure to chemicals in urban systems

332 Consumption of products - a proxy for changes in chemical flows in urban areas and to the environment?
E. Undeman, D. Bollinius, Stockholm University / Baltic Sea Centre; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. Löf, Stockholm University / Baltic Sea Centre

Is the threat posed to the environment by harmful chemicals increasing or decreasing? Due to the extremely large number of chemicals and variety of adverse effects, it is challenging to develop indicators for the success of our management of chemical emissions. Indicators for efficiency of chemicals management can be based on a) information on production, trade and use of chemicals, b) emissions, c) concentrations in humans and the environment and c) human and wild-life health, with data on the two latter being most relevant, but also difficult and/or expensive to produce for a wide range of chemicals. In this study, we use estimated consumption of products as point of departure to analyze time trends in use and emissions of chemical substances in the urban society and ultimately in the environment. Data on trade of manufactured products available in Eurostat was combined with chemical composition of products and materials compiled in the Commodity Guide hosted by the Swedish Chemicals Agency. The total mass of manufactured products in the northern Europe decreased slightly between 2005 and 2014. Despite this decline, ca 680 substances with significantly positive time trends due to increasing consumption of many products in which they are likely to be present were identified. We conclude, however, that substantially more data on chemical content of products is needed to successfully use consumption of products as a proxy for changes in chemical flows.

333 High-throughput assessment of use-phase exposures to chemicals in building materials
L. Huang, University of Michigan / Dept of Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; O. Jolliet, University of Michigan

Building materials have important contribution to the chemical exposure of the US population. The NHANES data have shown that the blood levels of brominated flame retardants and phthalate plasticizers, tend to be higher in children. The present study thus aims to develop a high-throughput method to determine exposures to chemicals in building materials, which mainly happen during the use phase but are often not considered in traditional LCA. The assessment framework calculates the product intake fraction metric, PiF, to assess consumer exposures during use phase, i.e the fraction of a chemical in product that is cumulatively taken in by the users. Based on the building materials Pharos database, 22 product categories for building materials and 218 chemicals were identified. We focus here on 632 unique chemical-product combinations, and assess doses based on PHAROS chemical content data. Chemical emissions from building materials are mainly determined by Dm (diffusion coefficient in building material) and Kma (material-air partition coefficient). Two simple emission models were developed for two types of behaviors: D-limited and K-limited. Use-phase exposures by inhalation, dermal contact, gaseous dermal uptake and dust ingestions were calculated using the PiF metric. Results showed that for SVOCs, the total PiF can be dominated by any of the four exposure pathways. Generally, the chemical-product combinations with low total PiFs are dominated by dust ingestion exposures, while the ones with high total PiFs are dominated by dermal contact exposures. For VOCs, inhalation PiF always dominates the total PiF. Generally, the PiFs of VOCs are similar between 50 days and 15 years, but the daily intake doses during 30 days are much higher than those during the entire 15-year use phase. In contrast, for SVOCs, the emissions and PiFs gradually increase when the duration of use is extended from 50 days to 15 years, but the daily intake doses remain similar over the total intake time. Overall, the intake dose, which combine the total PiFs and chemical content in building product, can range from 100 to 10^6 µg/kg-d for children. This study demonstrates the approach of high-throughput screening of use-phase exposures for chemicals in building products, which can be further integrated into characterization factors and help improve LCA and Chemical Alternatives Assessment (CAA) of consumer products.

334 OPEs - Where do they come from, where do they go? A case study from Toronto, Canada
T.F. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; Y. Adjei-Kyereme, University of Toronto / Earth Sciences; C. Yang, University of Toronto / Department of Earth Sciences; S. Harris, Cancer Care Ontario, University of Toronto / Population Health and Prevention, Prevention and Cancer Control; L. Jantunen, Environment and Climate Change Canada; M.L. Diamant, University of Toronto / Department of Earth Sciences

Organophosphate Esters (OPEs) are used in a wide range of consumer products and building materials resulting in their ubiquitous presence in the indoor and outdoor environment. Concentrations of OPEs in indoor air can be relatively high, in the range of 10^4 ng/m^3 in air. Concentrations are also relatively high in urban media (e.g., low ng/L levels in urban surface waters) and OPEs are commonly found in remote Arctic air. We hypothesize that elevated levels of OPEs in the indoor environment are a source to the outdoor urban environment and then to surrounding regions. To test this hypothesis, we estimated emissions of OPEs to indoor air followed by release to outdoor air, and then compared these “bottom-up” emission estimates to “top-down” estimated aggregate emissions to outdoor urban air. We used the approach of “inverse modelling”, whereby emissions are back-calculated from measured air concentration. “Bottom up” emissions were estimated using the Multimedia Indoor Model that has been used to calculate emissions of PBDEs and PCBs to indoor air, based on indoor air concentrations measured in a study of 51 homes in Ontario, Canada. “Top down” emissions were calculated using the Multimedia Urban Model based on measured Toronto outdoor air concentrations, main receptors for these molecules. Pharmaceuticals can be correlated to the CPC and TPhP, respectively. The emissions factors of OPEs from indoor air to outdoor air estimated in this study were within the range estimated by Liagkouridis et al. (2017) for bulk emissions to indoor air. These “bottom up” emissions from indoors to outdoors estimated here were one to two orders of magnitude lower than the “top down” estimates, which could be caused by higher emissions from commercial buildings or outdoor OPEs in indoor air from insulation. It is clear that elevated indoor and outdoor air concentrations of OPEs are due to emissions from the many products and materials to which they are added. When aggregated over a city scale, indoor air emissions vented to outdoor air were lower, but within one to two orders of magnitude of aggregate air emissions back-calculated from outdoor concentrations. Outdoor rate is governed by partitioning between air and high sorptive-capacity materials such as PUF in upholstered furniture and carpets and ventilation rate, as with other SVOCs. Outdoors, fate is governed by air advection and water movement, because of the high solubility of OPEs.

335 Drivers of pharmaceutical exposure in urban river systems
E.E. Burns, University of York / Chemistry; L. Carter, University of York / Environment Department; A. Boxall, University of York / Environment Department

Pharmaceuticals are heavily used by society and urban environments are one of the main receptors for these molecules. Pharmaceuticals can be correlated to the CPC and TPhP, respectively. The NHANES data have shown that the blood levels of brominated flame retardants and phthalate plasticizers, tend to be higher in children. The present study thus aims to develop a high-throughput method to determine exposures to chemicals in building materials, which mainly happen during the use phase but are often not considered in traditional LCA. The assessment framework calculates the product intake fraction metric, PiF, to assess consumer exposures during use phase, i.e the fraction of a chemical in product that is cumulatively taken in by the users. Based on the building materials Pharos database, 22 product categories for building materials and 218 chemicals were identified. We focus here on 632 unique chemical-product combinations, and assess doses based on PHAROS chemical content data. Chemical emissions from building materials are mainly determined by Dm (diffusion coefficient in building material) and Kma (material-air partition coefficient). Two simple emission models were developed for two types of behaviors: D-limited and K-limited. Use-phase exposures by inhalation, dermal contact, gaseous dermal uptake and dust ingestions were calculated using the PiF metric. Results showed that for SVOCs, the total PiF can be dominated by any of the four exposure pathways. Generally, the chemical-product combinations with low total PiFs are dominated by dust ingestion exposures, while the ones with high total PiFs are dominated by dermal contact exposures. For VOCs, Inhilation PiF always dominates the total PiF. Generally, the PiFs of VOCs are similar between 50 days and 15 years, but the daily intake doses during 30 days are much higher than those during the entire 15-year use phase. In contrast, for SVOCs, the emissions and PiFs gradually increase when the duration of use is extended from 50 days to 15 years, but the daily intake doses remain similar over the total intake time. Overall, the intake dose, which combine the total PiFs and chemical content in building product, can range from 100 to 10^6 µg/kg-d for children. This study demonstrates the approach of high-throughput screening of use-phase exposures for chemicals in building products, which can be further integrated into characterization factors and help improve LCA and Chemical Alternatives Assessment (CAA) of consumer products.

336 Past vs. recent emissions of PCBs from the city of Brescia (Italy): coupling monitoring data with a multimedia fate model to investigate PCB regional fate
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Drivers of pharmaceutical exposure in urban river systems
E.E. Burns, University of York / Chemistry; L. Carter, University of York / Environment Department; J. Thomas-Oates, University of York / Chemistry Department; A. Boxall, University of York / Environment Department

Pharmaceuticals are heavily used by society and urban environments are one of the main receptors for these molecules. Pharmaceuticals can be correlated to the CPC and TPhP, respectively. The emissions factors of OPEs from indoor air to outdoor air estimated in this study were within the range estimated by Liagkouridis et al. (2017) for bulk emissions to indoor air. These “bottom up” emissions from indoors to outdoors estimated here were one to two orders of magnitude lower than the “top down” estimates, which could be caused by higher emissions from commercial buildings or outdoor OPEs in indoor air from insulation. It is clear that elevated indoor and outdoor air concentrations of OPEs are due to emissions from the many products and materials to which they are added. When aggregated over a city scale, indoor air emissions vented to outdoor air were lower, but within one to two orders of magnitude of aggregate air emissions back-calculated from outdoor concentrations. Outdoor rate is governed by partitioning between air and high sorptive-capacity materials such as PUF in upholstered furniture and carpets and ventilation rate, as with other SVOCs. Outdoors, fate is governed by air advection and water movement, because of the high solubility of OPEs.
Different monitoring campaigns showed higher PCB concentrations in the air of cities compared to rural areas, indicating the presence of ongoing emission sources in urban locations. This is the result of both the past usage of these chemicals in building materials and electrical equipment from which they can volatilize and/or be released into the air. This study showed that cities could emit up to about 1 tons/year of PCBs (Gasic et al., 2009; Diamond et al., 2010), which can be transported to rural sites, posing adverse effects to human and ecosystems. The city of Brescia, is characterized by the presence of a factory (Caffaro s.p.a.) that produced PCBs between 1930-1984 and its surrounding areas were found to be heavily contaminated with high PCB concentrations in soil at mg/kg levels. For this reason, about 200 ha of this city were declared National Priority Site for remediation (SIN Brescia Caffaro) by the Italian authorities, representing an important secondary source of PCBs to the atmosphere. The aim of the present study was to investigate the potential of the Brescia city in driving the PCB contamination at regional scale up to 100 km from the point source and the current effects on air concentrations, combining measured data and a multimedia mass balance model. Different sampling campaigns were organized to collect samples of soil and leaves along four 100 km transects that ran in NW, NE, SW and SE directions considering the production plant as starting point. In each sample, the following PCB congeners were determined: PCB 28, PCB 52, PCB 101, PCB 153, PCB 138, PCB 180 and PCB 209. The results were analysed to estimate the relative contribution of far-field and near-field routes to PCB contamination at a regional scale.

Using a Dynamic Aggregate Exposure Model to Identify Far- and Near-Field Contributions to Human PCB Exposure through Time
L. Li, University of Toronto at Scarborough / Department of Environmental Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; F. Wanja, University of Toronto at Scarborough / Physical and Environmental Sciences; J. Cross, University of Exeter; T.S. Galloway, University of Exeter / Waterborne Environmental, Inc.

Humans are exposed to polychlorinated biphenyls (PCBs) through “far-field” sources from the ingestion of contaminated food from aquatic and terrestrial environments and “near-field” sources from building materials in indoor environments. Earlier models that consider far-field exposure only tend to underestimate historical body burdens. In this presentation, we will explore the time-dependence of the relative contribution of far-field and near-field routes to aggregate human exposure to PCBs, to explain the discrepancy between previous far-field only model predictions and observations. We develop a mechanistic model that incorporates dynamic substance flow analysis, indoor-urban-rural fate modeling, and bioaccumulation and human toxicokinetic modeling, enabling a dynamic and mechanistic description of the complicated continuum from annual industrially processed amount of PCBs to the human uptake rate. The model is applied to simulate the time-variant exposure of Swedish women to PCB-28 and PCB-153 from 1930 to 2030. In terms of a female’s lifetime longitudinal exposure, our modeling indicates that route-specific contributions to aggregate human exposure change with age and differ among birth cohorts: Near-field exposures are notable during childhood and teenage years, as well as for female cohorts born earlier, while the indoor environment was more highly contaminated. In terms of the exposure of individuals of different ages at the same time (i.e., the cross-sectional age-exposure relationship), the dominance of far- or near-field routes differs little among ages, but is largely dependent on the time a cross section is “sampled”: Near-field routes dominate in the past (e.g., the year 1956) whereas far-field routes become predominant more recently (e.g., 1986 and 2016). This finding suggests that the dearth of PCB biomonitoring studies before 1990s has also contributed to the general belief that far-field sources dominate human PCB exposure. It further implies that there may also be a similar shift from a near-field dominance to a far-field dominance among a wide range of currently-used indoor chemicals, such as flame retardants. This work improves our understanding of the exposure dynamics, which would be beneficial for future pertinent management actions for exposure reduction and prevention.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (II)

Modelling of the environmental release of macro- and microplastics for seven different polymers
D. Wenger, Empa Swiss Federal Laboratories for Materials Science and Technology; B. Nowack, EMPA

Microplastic exposure is a burning topic in environmental research, but few large scale exposure studies have yet been performed in freshwaters. Assessing the emissions of plastic is possible using a life-cycle oriented approach, and permits to compare the flow magnitudes for different sources. With our ongoing study, we aim at providing large scale predictions of macroplastic and microplastic exposure in Europe. The probabilistic aspect of the PMFA framework permits one to account for the various uncertainty sources and give a quantitative estimate of the final confidence in the results. In a first step, the anthropogenic life cycle of these seven polymers is modelled, from production to end of life of a total of 35 product categories. Various trade flows are included, as well as the life cycle of textile applications. This enables us to present an accurate estimation of the European and Swiss plastic emissions. In a second step, every stage of the life cycle is analyzed and the voluntary or inadvertent emissions are assessed. The emission-specific pathways between the anthroposphere and the environment are described, and the resulting environmental flows are compared. Modelling the emission pathways between prime release and final discharge enables to pin-point the principal plastic pollution sources and the possibilities for pollution mitigation.

Modelling Microplastics in Rivers in the US
A. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; C. M. Holmes, Waterborne Environmental, Inc.

Pollution with nanoplastics is the focus of this poster. The presentation will compare the flow magnitudes for different sources. With our ongoing study, we aim at providing large scale predictions of macroplastic and microplastic exposure in Europe. The probabilistic aspect of the PMFA framework permits one to account for the various uncertainty sources and give a quantitative estimate of the final confidence in the results. In a first step, the anthropogenic life cycle of these seven polymers is modelled, from production to end of life of a total of 35 product categories. Various trade flows are included, as well as the life cycle of textile applications. This enables us to present an accurate estimation of the European and Swiss plastic emissions. In a second step, every stage of the life cycle is analyzed and the voluntary or inadvertent emissions are assessed. The emission-specific pathways between the anthroposphere and the environment are described, and the resulting environmental flows are compared. Modelling the emission pathways between prime release and final discharge enables to pin-point the principal plastic pollution sources and the possibilities for pollution mitigation.
an ecologically relevant system, using the freshwater aquatic worm Lumbriculus variegatus, representing an entry point for nanocontainers from abiotic compartments of sediments, into biota. The role of surface functionalisation of fluorescently dyed nano-polystyrene (50 nm) upon their uptake is systematically examined using a combination of techniques including a novel fluorescence assay and fluorescence microscopy. A series of exposure scenarios are used to test the efficacy of different routes of uptake into the worms. Associations of nanocontainers to the worms’ surface are examined in waterborne exposures, whilst dietary uptake is tested using nanocontainers associated with an algae food source. The accumulation of nanocontainers directly from contaminated sediments is also investigated, alongside the fate of these particles in sediments to assess the relationship between nanocontainers mobility and accumulation. Results indicate that pristine nanocontainers and those coated with PEG are taken up into worms in a similar way to pristine microcontainers. Taking dietary uptake in consideration, results indicate that the magnitude of accumulation is dependent on the size of nanocontainers, with smaller containers leading to higher accumulation in the worm. Overall, the results emphasize the potential of nanocontainers to be ingested by aquatic organisms and should be further investigated to fully assess their potential impact on the aquatic environment.

341 Life-history and biochemical responses of Chironomus riparius exposed to different sized microplastics
C. Silva, CESAM/University of Aveiro; I. Pestana, CESAM & University of Aveiro / Biology; C. Gravato, Faculty of Sciences, University of Lisbon / department of Biology & CESAM

Freshwater basins are an integral part of microplastics life-cycle, being a repository of plastic micro-debris. In fact, the levels found so far are similar to those found in marine environment and shoreline regions. The deposition and persistence of plastic micro-debris in sediments (lakeshores and rivers) makes them long-time available for benthic species. The objective of this study was to investigate developmental, and physiological effects induced by the presence of polyethylene microparticles (PE) in Chironomus riparius, due to its key-role in the freshwater ecosystem. For that partial life cycle tests using different sized polyethylene particles (PE 40-48 µm; PE 125 µm and PE 350 µm) allowed evaluation of effects on C. riparius larval growth and emergence patterns while acute exposures were used to assess effects in parameters related to neurotransmission (AChE); antioxidant defences and biotransformation (CAT, GST total glutathione levels); oxidative damage (LPO); cellular energy allocation (AChE); antioxidant defences and biotransformation enzymes activities (CAT, GST and total glutathione) and activation of immune response (induction of phenoloxidase). Larvae exposed to microplastics showed also a depletion in energy reserves. Our study highlights the potential deleterious effects of microplastics for aquatic invertebrate populations. Results will be discussed in terms of effects of different sized plastic particles on different levels of biological organization within freshwater invertebrates and on the needed and ongoing research aiming to address the long-term and indirect effects of these particles for natural populations and ecosystem functioning.

342 The effects of rigid and flexible Polyvinyl chloride (PVC) microplastic particles on the transcriptome of Daphnia magna
B. Troester, University of Bayreuth / Animal Ecology I; I. Schrank, I. Dummert, K. Wing, C. Laforsch, University of Bayreuth

Microplastics are ubiquitous in aquatic ecosystems, posing as a threat to biota of all trophic levels, as they have the potential to leak out incorporated additives, such as plasticizers, to the surrounding medium. Yet the question arises, if possible effects on biota are based on the polymer type alone, or if incorporated additives are responsible for the observed effects. In the current study, we considered two different types of endopeptidase inhibitor activity. Flexible PVC exposition lead to a fivefold change of a total of 267 genes (238 up-regulated and 29 down-regulated) related to the GO terms of proteolysis, carbohydrate and chitin metabolism, Vitrilin membrane formation, yet most genes were related to immune response. Our attained results imply that flexible PVC had a more severe effect that might be attributed to the level of DINP (bisphenol A detether biofilm formation) on these two different microplastic particles. Therefore our results highlight, for the first time that differences in additive composition (absence or presence of a plasticizer) can lead to substantial differences in effects on aquatic species.

When ecotoxicology meets trophic ecology

343 Poster spotlight: TU149, TU150, TU151

Does stress propagate along aquatic food chains? An experimental approach with a tri-trophic brown food web
E. L. Fernandes, University of Koblenz Landau; M. Bundsche, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences Pollution is a major driver of ecosystem change resulting in alterations in food webs and associated ecosystem processes. Some pollutants such as systemic insecticides are taken up by terrestrial plants and may enter aquatic systems with plant parts such as leaves that are an important energy source in stream food webs. Therefore, food web interactions across the aquatic-terrestrial boundary may be affected through alterations in food quality. Here we studied the effects of a systemic insecticide, the neonicotinoid imidacloprid, and their potential propagation in a brown food chain. The model food chain consisted of imidacloprid contaminated terrestrial leaves (alder, Alnus glutinosa Gaertn.), aquatic meromictic invertebrate decomposers (Protonemura sp.) and predators (Isoperla sp.). Effects of imidacloprid on survival and growth of decomposers and its leaf processing were assessed in a microcosm setting. Therefore, decomposers fed on control or contaminated leaves for 3 days on the microcosms. Every 6 hours the number of dead individuals was recorded. Potential propagation of imidacloprid effects were assessed by transferring surviving decomposers to cages containing the predator. The cages were deployed in an unpolled stream for 9 days after which predators’ growth was analysed. Imidacloprid concentrations increased within the contaminated microcosms over time. The presence of imidacloprid in the water was associated with lower survival of decomposers and leaf decomposition.

345 Accounting for trophic relationships in fish bioconcentration models applied when emergent-pollutants risk-assessment tools are used
h. baervo, Wageningen Environmental Research; J. Denée, Wageningen Environmental Research; H. Faust, Wageningen Environmental Consulting; J. van Gils, DELTARES; C. Lindim, Stockholm University / SEAC; A. Focks, Alterna Wageningen University and Research Centre / Environmental Risk Assessment Team

In the context of the SOLUTIONS EU FP7 project, we applied non-steady state bioconcentration models to predict concentrations of organic compounds in fish. A foodweb perspective was taken, accounting for uptake from water as well as from food, and accounting for different trophic relationships for several fish species used for human consumption. The foodweb bioconcentration model will be applied for a large number of emerging pollutants and a large number of locations (around 25,000 sub-catchments in the major European catchments). Water concentrations at these locations are obtained from chemical fate modelling using the STREAM-EU model. As a case study, results for 24 WFD priority substances are presented here. Predicted concentrations will be input to human health risk assessment. The model also provides insights into how trophic relationships together with species and compound characteristics determine bioconcentration and thus ecotoxicological risk. The core of the foodweb model is a bioconcentration model for neutral and ionisable organic compounds (Arnot & Gobas 2004; Armitage et al. 2013) underlying each fish component. It calculates for given environmental conditions (pH and temperature) the uptake and elimination rates defining the one-compartment model of the internal concentration dynamics. The considered foodweb contains fish components with different trophic relationships, representing fish species used for human consumption with different body size and lipid content, chosen to represent extreme cases with respect to expected bioconcentration. Internal concentrations in phyto- and zooplankton are assumed to be in instantaneous equilibrium with water concentration. For 24 WFD priority substances concentration timeseries per sub-catchment from the STREAM-EU model were used as input to the foodweb bioconcentration model. Results were summarized in monthly and annual maximum and mean concentrations for all foodweb components in each sub-catchment and displayed in maps covering the
EU. From these results, e.g., median concentrations can be calculated per catchment or over all catchments. Concentrations in fish depend on local exposure pattern and differ per subcatchment. They also depend on trophic position in a compound-specific way: any of the three fish components can be worst-case. To indicate risk to human health, concentrations need to be related to standards of e.g., acceptable daily intake.

346 Model-based explorations of the variableness in lake trout BAFs caused by physiology and trophic relationships

S. Baskaran, University of Toronto - Scarborough / Chemistry; J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; F. Wörner, University of Toronto at Scarborough / Physical and Environmental Sciences

Because dietary uptake of fish is often a major vector of human exposure to persistent organic pollutants (POPs), much effort is directed towards a quantitative understanding of fish bioaccumulation with the help of mechanistic models. Such models require the input of the growth, feeding and respiration rates of a fish. However, often little consideration is given to the interdependency of these physiological parameters. Here, we calculate the bioaccumulation factor (BAF) of hypothetical POPs, with log $K_{ow}$ values ranging from 4.5 to 8.5, in lake trout (Salvelinus namaycush), with a food web bioaccumulation model that uses bioenergetic equations to ensure that the physiological parameters applied to a species are internally consistent (i.e. energetically balanced). Empirical growth rates and diets for lake trout in six Canadian lakes (Lake Slave Lake, Lake Ontario, Source Lake, Happy Isle Lake, Lake Opeongo, and Lake Memphremagog) are used to determine feeding rates. Respiration rates were derived based on the routine metabolic rates and the population specific activity coefficients (multipliers). When comparing differently sized lake trout within a lake, larger fish tend to have the highest BAF, because they allocate less energy towards growth than smaller fish and have higher activity levels. When comparing fish from different lakes, diets composition and prey energy density become important in determining BAF in addition to activity and the amount of total energy allocated to growth. Specifically, fast growing Lake Ontario lake trout, feeding on slow growing alewife, have higher BAFs; while slower growing small lake trout in Happy Isle and Source Lakes have very low BAFs because they feed on invertebrates, which are low in the food chain. Moreover, very large trout in Great Slave Lake with higher energy requirements feeding on an energy rich diet have lower BAFs compared to the same sized trout in Lake Memphremagog feeding on less lipid rich rainbow smelt.

347 Influence of an agriculture-associated toxicity gradient on a riparian predator-prey relationship in Romania

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Riparian areas have been identified as hotspots of aquatic pollutant loadings and related to riparian vegetation. To better understand the bioaccumulation behaviour of chemicals in terrestrial food webs, we aim to produce a food web model to assess the biomagnification of POPs in an apex avian predator, the Cooper’s hawk (Accipiter cooperii). To investigate the spiders’ diet, aquatic and terrestrial predator organisms were caught. We collected the orbweb Tetragnatha sp. and the ground-dwelling spider Pardosa sp. to analyse their stable carbon and nitrogen signals. Nutrient concentrations in the stream were slightly positively associated with the proportion of aquatic prey of Pardosa sp. This may be explained by nutrients in the streams increasing productivity of primary producers and in turn resulting in a larger biomass of emerging insects. The toxicity gradient was negatively related to the number of individuals of spiders and the number of species. Although we found clear differences in the proportion of consumed aquatic prey of spiders, the proportion of it was not related to the toxicity gradient. Thus, potential effects of pesticides in the aquatic system did not affect the proportion of consumed aquatic prey organisms of riparian spiders. We found less individuals of Tetragnatha sp. when they consumed more aquatic prey. This might be due to an accumulation of toxicants in the spiders or a higher competition between the species due to resource shortage. Riparian spiders can be affected directly by agricultural land use but also indirectly via prey consumption. Changes in riparian spider communities and their diets are presumably driven by multiple stressors.

348 Migration effects on pollutants in eggs of Arctic-breeding geese

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Arctic breeding barnacle geese (Branta leucopsis) are a herbivorous species that migrate from the United Kingdom to the Arctic every summer to breed. Females utilise resources towards reproduction along the flyway, including distant resources (United Kingdom and Northern Norway) and local resources (Svalbard) relative to the breeding grounds. Depending on migration route, allocation of resources towards egg production may differ within a breeding goose population. Thus, different energy sources may also affect how pollutants are taken up and deposited to eggs, including those which are both protein and lipid soluble. In order to examine the effect of migration on pollutants in eggs, a field study was carried out during the breeding season of 2016. Eggs (N = 60) were collected at an island breeding colony in Svalbard and several hundred grams of vegetation (N = 15 samples) were collected at different sites along the geese’s flyway. Resignments of ringed geese also took place in Northern Norway. Egg and vegetation samples were analysed for stable isotope of carbon (δ13C) and nitrogen (δ15N), as well as pollutants including protein-associated poly- and perfluoroalkyl substances (PFAs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be explained directly by agricultural land use but also indirectly via prey consumption. Changes in riparian spider communities and their diets are presumably driven by multiple stressors.
Toxicokinetic-toxicodynamic models as new tools for environmental risk assessment

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Today, the Environmental Risk Assessment (ERA) for chemicals is based on fitting standard dose-response (DR) models to quantitative data. Such data are usually collected from standard toxicity tests, from which the concentration leading to 50% lethality or effect (LC₅₀ or EC₅₀) is usually estimated at the end of the exposure. In this form of evaluation, the fact that endpoints are monitored over time is not fully exploited. Standard DR models do also assume that the exposure concentration remains constant during the experiment, what makes it difficult to extrapolate the results to more realistic exposure scenarios, for example to effects under time-variable exposure profiles. To overcome this gap at the organism level, the use of the toxicokinetics-toxicodynamics (TKTD) models is suggested, because TKTD models describe the effects of a substance by integrating the dynamics of exposure [1]. Indeed, TKTD models have many advantages in terms of mechanistic understanding of the chemical mode of action, of deriving time-independent parameters, of interpreting time-varying exposure and of making predictions for untested and time-variable exposure. Another advantage of TKTD models for ERA is that they make it possible to calculate any LC/EC₅₀ for arbitrary effect strength r and any given exposure duration t. Nevertheless, being based on differential equations their mathematical complexity makes it necessary to numerically integrate the equations when fitting the model to data, so that in practice TKTD models are still not used, there are still no tools to allow users to fit TKTD models for regulatory risk assessment without suffering any technicalities, the availability of a software environment for an easy handling of TKTD models would be of great value. That is the aim of the R package ‘morse’ in its new version 3.0.0. [2]. In this presentation, we will give an overview of TKTD models with a focus on the General Unified Threshold model for Survival (GUTS, [3]). Handling GUTS models and GUTS data will be then illustrated with one example dataset. Finally, the added-value of TKTD models for ERA will be discussed based on a number of different datasets.

351 Lethal and sublethal impacts of neonicotinoids and copper nano-particles on the energy budgets of an estuarine amphipod

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Estuaries are major recipients of run-off pesticides from agricultural and urban origin, including neonicotinoids and nano-based copper formulations. Neonicotinoids have rapidly become the most widely used insecticides globally, and have been implicated for harming pollinators and non-target species at levels below existing US EPA toxicity thresholds. With most research conducted on isolated effects, there are scant data to allow us to use TKTD models for regulatory risk assessment without suffering any technicalities, the availability of a software environment for an easy handling of TKTD models would be of great value. That is the aim of the R package ‘morse’ in its new version 3.0.0. [2]. In this presentation, we will give an overview of TKTD models with a focus on the General Unified Threshold model for Survival (GUTS, [3]). Handling GUTS models and GUTS data will be then illustrated with one example dataset. Finally, the added-value of TKTD models for ERA will be discussed based on a number of different datasets.

352 A biology-based model to analyze growth data of earthworms exposed to copper at different development stages

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Assessing effects of a contamination on populations requires getting data on the whole life cycle and accounting for sensitivity of species to environmental conditions throughout this life cycle. Copper contamination is one of the greatest concerns in agricultural soils, especially in vineyards. This contamination may have negative effects on soil fauna, such as earthworms, which are recognized as ecosystem engineers providing very valuable ecosystemic services. To assess effects of copper on earthworm populations, we tested the impact of a commercial formulation of copper fungicide, i.e. Cupra Micro® (50% copper oxichloride), on different endpoints, including growth, for the earthworm species Aporrectodea caliginosa, one of the dominant earthworm species in agricultural fields. We performed original tests assessing the impact of copper on the growth at 3 different development stages with many times of replicates: new hatched juveniles (10-15 mg), juveniles (90-110 mg) and large juveniles (260-340 mg). To analyze simultaneously all the data, we developed and used a biology-based model. This model is based on the DEB (Dynamic Energy Budgets) theory. A DEB model was set up and validated under controlled conditions, using different food conditions. The growth data were then analyzed with a toxicokinetic model (analyzing impacts of growth and differences between development stages) coupled with a DEB-based toxicodynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 65 mg kg⁻¹ of copper for all stages, was exceeded. The time-profile of the effects was fully accounted for by the model. In conclusion, our model provided a relevant analysis of the toxicity data and provided understanding of the mechanisms of copper toxicity to earthworms throughout their development. The next step of our research will be to combine our biology-based model and reproduction data in a dynamic population model.

353 Connecting suborganismal and organismal responses using Dynamic Energy Budget Modeling and the ecological model species Fundulus heteroclitus exposed to dioxin-like chemicals

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Comprehensive and efficient management of ecological risks depends on our ability to quantitatively extrapolate the effects of stressors across levels of biological organization. Adverse Outcome Pathways (AOPs) connect sub-organismal mechanistic molecular data to organismal outcomes, while bioenergetics models, such as Dynamic Energy Budget (DEB), can extrapolate from individual- to eco-organismal-levels of toxicant exposure. However, the connection between the two modeling frameworks remains a challenge. The molecular mechanisms underlying Key Event (KE) relationships defined in AOPs are often poorly known, even for well-studied compounds; thus, the mechanistic linkages between KEs and effects on DEB processes are often difficult to discern. Further, AOPs whose adverse outcome is lethal or sublethal are challenging to fit to a DEB-based model. Thus, the connection between KEs and DEB effects is difficult to establish. We address these challenges through theoretical and empirical efforts. We connect AOP KEs to DEB processes through a model of life history dynamics. The model predicts regulated but increasing concentrations of damage as the result of toxicant exposure and also tipping points when damage outpaces regulatory feedbacks, leading to mortality (Klanjsek et al. 2016). The connection between damage dynamics and DEB will be influenced by empirical and theoretical observations, but potential linkages include damage causing an increased maintenance cost or specific impacts on development. Specifically, we are studying the effect of DLCs on Fundulus heteroclitus (Atlantic killifish). DLCs are of particular interest in this species due to the large intraspecific variability in sensitivity. There is extensive data describing the toxic effects of DLCs through chronic effects endpoints (the AHR pathway). The mechanism linking these endpoints is unknown. Further, sublethal effects of DLCs are less studied, but preliminary data indicate that sublethal PCB1216 exposure leads to slower growth in larval killifish (Nacci unpublished data). Therefore, this system offers a framework to test our ability to connect effects observed at the suborganismal level to bioenergetic processes through AOP and DEB modeling. We will measure suborganismal effects of DLCs (cytochrome P450 activation & transcription) along with effects on development, growth, and reproduction. We will give an overview of our objectives and methods and report preliminary findings fitting DEB models and predictions of the effect of DLCs on the bioenergetics of killifish.

354 Quantitative Adverse Outcome Pathway Modelling of Endocrine Active Toxicants in Rainbow Trout

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We are investigating best approaches to utilizing in vitro derived toxicity data for estimating impacts on reproduction in trout and salmon. Our goal is to facilitate development of quantitative data in vitro – in vivo extrapolation (IVIVE) methods to support adverse outcome pathway (AOP) based toxicity testing. We tested a diverse suite of toxicants using cellular assays based on the female rainbow trout pituitary, ovary and liver. Each assay measures an essential reproductive endocrine function

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such as estrogen synthesis and secretion by ovarian follicles. In vitro results are extrapolated to metrics of reproductive performance (fecundity, fertility, egg size) in trout using a mathematical model of the trout hypothalamus-pituitary-ovary-liver (HPOL) axis. We evaluated IVIVE by comparing predicted effects against laboratory results obtained from a yearlong exposure of female trout to four different chemicals: tamoxifen (biotransformed into the anti-estrogen 4-OH-tamoxifen), prochloraz (interferes with cysteine maturation), fluoxetine (SSRI pharmaceutical largely negated in our in vitro assays) and trenbolone (potent synthetic androgen). A single water exposure level was tested for each chemical, guided by preliminary studies and a desire to use a maximum tolerated exposure that still allowed spawning to occur. Laboratory exposures began 10 d after the first spawning cycle and lasted until time of ovulation and completion of the second spawning cycle 12-14 months later. Trout were euthanized and total fecundity determined along with egg mass and diameter, fertility, hatching success and larval growth. Results indicated no effect on fecundity was observed except after the 60 ng/L trenbolone exposure, which caused regression of ovarian growth and a failure to spawn in all exposed fish. Fluoxetine had no effect on reproduction. The most significant effects on egg quality occurred after the 500 ng/L tamoxifen (30% decrease in egg mass and diameter) and 20,000 ng/L prochloraz (increase in atretic / non-fertile eggs) exposures. The tamoxifen induced decrease in egg size translated to significantly smaller larvae at 20 dph. The HPOL model, guided by in vitro testing, accurately predicted the reproductive effects of prochloraz and tamoxifen and the lack of effect by fluoxetine. Our results support the use of biologically based mathematical models of physiological systems in AOP testing. Supported by EPA-STAR grant R835167.

Development of a PBPK model for metal accumulation in fish infected with acanthocephalan parasites

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Fish are affected by both exposure to metals and infection. Each of these stressors may have effects on fish physiology and function. Some of these effects have recently been made in developing kinetic models for predicting metal accumulation in fish-parasite systems. Our previous model allows for investigating the relationship between the accumulation in the whole fish and in the acanthocephalan, but does not include the mechanisms how metals are accumulated in parasites. Physiologically based pharmacokinetic (PBPK) model has been used for simulating the metal-specific accumulation of pollutants. However, the capability of this model for simulating fish-parasite systems has not been investigated. We developed a PBPK model for simulating Ag accumulation in the host-parasite system: chub (Squalius cephalus) and the acanthocephalan Pomphorhynchus terecticollis. The acanthocephalan was considered a compartment, similar to blood, storage, gills, kidney, liver, and intestine. Metal accumulation in the system was modelled as a function of internal (i.e. exchange between different compartments) and external (i.e. exchange with water) factors. The transport from blood to other compartments depends on the diffusive exchange and the fraction of metals dissolved in blood plasma and was assumed to be independent of the infection state. The rate constants for this transport were parameterised based on published data. The model was then calibrated by MATLAB-based AMIGO modelling software for determining the rate of uptake from storage, gills, kidney, liver, and intestine to blood as well as the external exchange. Model calibration was carried out by using experimental data generated when the infected chub were exposed to Ag in 48-day exposure and 51-day depuration periods. The initial results from model calibration show potential of the PBPK model for simulating the accumulation of metals in fish-parasite systems. For example, the model could simulate the changes in the concentration of Ag in storage, gills, and intestine. The stability in the concentration of Ag in kidney was also simulated by the model. However, the model is being further calibrated to improve its capacity for modelling the accumulation in liver and in the acanthocephalan. The observed weakness of the current version in modelling the accumulation of Ag in these compartments might be related to the approaches for simulating the excretion of organo-metal complexes to intestine. Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (III)

High-throughput exposure and risk modelling of chemicals in European river basins

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SOLUTIONS is a EU 7th Framework Programme R&D project that aims at strengthening the management of emerging contaminants. It developed a collection of integrated models (the “Model Train”), to increase our understanding of issues related to emerging chemicals in Europe’s river basins, to support the prioritisation of chemicals and the abatement of the problems they cause and to evaluate future scenarios. The model train consists of four key building blocks: (i) the prediction of substance properties based on their molecular structure, (ii) the simulation of emissions, (iii) the simulation of fate & transport, and (iv) the characterisation of the risk of mixtures of chemicals for human health and aquatic ecosystems. The Model Train does not rely on extensive substance-specific input data. This implies that the approach is truly “emerging”, can handle a large number of chemicals and for large numbers of chemicals (“real world exposure scenario”). The approach is validated for well-studied substances and data-rich basins. On this basis we learn how accurate our model based predictions are for new substances and data poor basins. The model train operates on the scale of Europe as a whole or for one or more individual river basins. It makes use of the pre-existing Europe-wide hydrology model, H-E-Hype. The Model Train complements lab and field based approaches, by providing information for substances and sites which are not included in monitoring and by providing full time coverage. Validation results for the Danube, Rhine, four Spanish and a series of Swedish River Basins reveal that the accuracy of the simulated concentrations of a range of chemicals is higher for substances with a single type of use (e.g. pharmaceuticals, pesticides) and lower for substances with many uses. The prediction chemical and biological monitoring results, lends support to the reality of the correlation of the observed ecological status as EU Member States report it under the Water Framework Directive. The SOLUTIONS Model Train will offer an effective tool to screen a large number of chemicals on their impact on Europe’s aquatic ecosystems, and to do so with consideration for spatial and temporal gradients as governed by socio-economic and meteorological/hydrological patterns in combination with the chemicals’ physical and toxicological properties. The presentation will include the validation results and will highlight some of the Model Train application results from SOLUTIONS.

Forward-looking on possible impacts of chemical pollution: Modelling lethal and sublethal effects of chemical exposure on population viability for aquatic macroinvertebrates

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One challenge in the quality assessment of water bodies in Europe is the ongoing difficulty to link the chemical and the ecological status. Currently, new approaches are expected to provide a holistic and pragmatic monitoring, starting with a correlation and by providing the means to elucidate possible chemical impact on the ecological status of European water bodies in a retrospective way. Ecological modelling provides an alternative approach to connect exposure information to potential impact on biota, having the advantage that such modelling can be performed in a prospective way. This presentation will show results of ongoing modelling efforts in the EU 7th framework program, H-E-Hype. The approaches are applied to link exposure dynamics of a number of chemical compounds to parsnimous individual-based population models. The STREAM-EU model provides exposure concentration results at the level of subcatchments, that is at a scale of tenths of km². Links between exposure and effects are realised using linear or log-logistic dose-response relationships. The ecological models account for lethal and sublethal effects on the population dynamics of a number of families of aquatic macroinvertebrates. Impacts of multiple chemicals are added up in the model following basic mixture modelling rules. Results depict the simulated inhibition of population growth rates and hence the chemical impact on population viability at European scales. Ecological modelling results are for some selected part of Europe compared with available monitoring information on the abundances of macroinvertebrate families in order to get an impression about the quality of the model predictions.

Eco-epidemiology of aquatic ecosystems: aligning chemical and ecological status

L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; S. Birk, University of Duisburg-Essen / Aquatic Ecology; A. Burton, University of Michigan / School of Natural Resources Environment; D. De Zwart, DdZ Ecotox / Centre for Sustainability Environment and Health; S.D. Yder, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; C.M. Holmes, K.E. Kapo, Waterborne Environmental, Inc.; D. van de Meent, Association of Retired Environmental Scientists ARES / SETAC Europe 28th Annual Meeting Abstract Book
Sustainability Environment and Health

This paper analyses water quality assessment and management specifically looking at the diagnosis of toxic effects of mixtures in field ecosystems. We apply various methods to liaise ecosystem responses to mixture toxic pressure under natural, variable and multi-stressed conditions. We collated vast amounts of monitoring data to explore those diagnostically, in line with the Father of Epidemiology, dr. Snow, who famously provided a solution to a cholera outbreak in Soho, London, 1854, by epidemiological reasoning. So, this paper represents a set of contemporary eco-epidemiological results, the recognition of ecological impacts in surface water systems, and the diagnosis of probable causes. The paper presents the utility of that for chemical- and water quality assessment and management, thereby bridging preventive policies such as REACH via e.g., a Mixture Assessment Factor and environmental management measures such as the EU\'s Directive. We present novel results of scientific research at the nexus of chemical and water policies, connected to the European goals to reach a non-toxic environment and the good chemical and ecological status for aquatic systems. The presentation consists of the analyses of vast sets of surveillance monitoring data using a combination of techniques originating from the fields of bioassessment and ecotoxicology. It thereby bridges these – so far often disparate – scientific disciplines, to support sustainable chemical and water policies. One of the most recent examples is provided by a diagnostic analysis in which the Good Ecological Status appeared associated to the Good Chemical Status, the latter shown to be a limiting factor for reaching a good ecological status. The presentation will provide a rationale for eco-epidemiological analyses as well as various types of results, from diagnostics to prognosis and outreach. The Future EU project MARS (Mixing Aquatic and early stress characterization of chemical mixtures up till a solution-focused approach related to ecosystem services management goals. We present specifically a body of evidence for the wide-spread occurrence of chemical mixture impacts in current water systems at the continental and national scale (Netherlands), corroborating recent findings of this kind based on chemical risk.

359 Unravelling the cocktail of stress: toxics and other stressors impacting on the ecological status of Europe\'s rivers

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Water management requires solid understanding of how multiple stressors affect ecosystem state and outreach. The Future EU project MARS (Mixing Aquatic ecosystems and water Resources under multiple Stress) recently concluded four years of in-depth research on this topic. MARS looked into multi-stressor responses from experimental water body to pan-European scale, developed tools for modeling and diagnosing multi-stressor effects and guided management of multiplied stressed aquatic ecosystems. Our presentation summarizes the key conclusions of the project, with a special emphasis on pan-European multi-stressor effects on the ecological status, including river hydrology, morphology, nutrient and toxic stressors.

360 Mitigation options for chemicals of emerging concern in surface waters - operationalizing solutions-focused risk assessment

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Chemicals of emerging concern (CECs) in the water cycle have been the focus of research for over a decade. New and emerging contaminants can cause short- and long-term adverse effects. The potential consequences for chemical use and releases: public health, food production, urbanization and technologies. With these further developments and the introduction of new substances from new sources, an adaptation of current regulatory frameworks is required. However, to prepare for a future with unknown scenarios for use and emissions of potential chemical pollutants is naturally difficult but a general approach can be developed and adopted to prepare for a future where environmental pollution by chemicals is avoided or minimised. This general approach should build upon a few basic principles: (1) The solution-focused approach, with the same attention to both costs and benefits of new substances within the whole aquatic environment. (2) The ecosystem approach, with the same attention to both costs and benefits of new substances within the whole aquatic environment. (3) Some of the main advantages of the ecosystem approach are: (a) The ecosystem approach is more realistic and more flexible. (b) The ecosystem approach is more holistic. (c) The ecosystem approach is more adaptive. (d) The ecosystem approach is more participatory. (e) The ecosystem approach is more transparent. (f) The ecosystem approach is more inclusive.

361 Future perspectives of chemical pollution and regulatory development

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Future developments in society will result in the emission of new substances to the environment which will require an adaptation of existing legislation for protection of human health and ecosystems. Scenarios for the future development of society can provide valuable indications on changes in future pollutants in river basins. Some developments are directly connected to consumption of specific substances, e.g. demographic change where a longer life expectancy will lead to changes in amounts and types of pharmaceuticals used and thus also to the related concentrations in the environment. Future technological progress may help to identify alternative and user-friendly technologies for the removal of non-polar pollutants, flame retardants or nanomaterials but may also introduce new substances with negative impacts on aquatic ecosystems. Four societal sectors have been identified where major changes within the next two decades can be expected which have potential consequences for chemical use and releases: public health, food production, urbanization and technologies. With these future developments and the introduction of new substances from new sources, an adaptation of current regulatory frameworks is required. However, to prepare for a future with unknown scenarios for use and emissions of potential chemical pollutants is naturally difficult but a general approach can be developed and adopted to prepare for a future where environmental pollution by chemicals is avoided or minimised. This general approach should build upon a few basic principles: (1) The solution-focused approach, with the same attention to both costs and benefits of new substances within the whole aquatic environment. (2) The ecosystem approach, with the same attention to both costs and benefits of new substances within the whole aquatic environment. (3) Some of the main advantages of the ecosystem approach are: (a) The ecosystem approach is more realistic and more flexible. (b) The ecosystem approach is more holistic. (c) The ecosystem approach is more adaptive. (d) The ecosystem approach is more participatory. (e) The ecosystem approach is more transparent. (f) The ecosystem approach is more inclusive.

362 Eco-leaders: a systematic approach for the assessment of multiple stressors: Making Aquatic Ecosystems Great Again (MAEGA)

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Climate Change Canada; K. Dafforn, Macquarie University / Evolution to Ecology Research Centre; L.E. Johnston, University of New South Wales / Evolution and Ecology Research Centre; K. Korbel, Macquarie University; D. Lapan, University of New South Wales; M. Mayer-Pinto, University of New South Wales / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; W. Monk, Environment and Climate Change Canada; A. O'Brien, Agriculture and Agri-Food Canada; N. T. Paton, Environment and Climate Change Canada; K. Scholten, R. Verdonck, Wageningen University; P. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra

In the Anthropocene, ecosystems are exposed to a range of stressors that if not properly managed can lead to ecosystem state shifts and significant losses in ecosystem services. We held a workshop (September 2017, Wageningen, The Netherlands) to develop a conceptual framework to assess the effects of multiple stressors on the structure and functioning of aquatic ecosystems. This framework was subsequently applied to three ecosystem types (ditches, floodplains and harbours). The proposed framework consists of two parts: an environmental filter and a transmitting function to allow effects to propagate to higher levels of biological organisation. Applying the framework consists of the following steps: 1) Select an ecosystem of concern; 2) Identify stressors and potential interactions; 3) Identify receptors/sensitive groups for each stressor; 4) Identify stressor-response relationships and group stressors according to their mode of action; 5) Construct an ecological model that includes relevant functional groups and endpoints; 6) Predict the resultant impact of multiple stressors; 7) Confront the predictions with experimental and monitoring data; 8) Adjust the ecological model if needed. Steps 7 and 8 can be repeated until a satisfactory match between model predictions and experimental and monitoring data has been obtained. The workshop will present the details of the framework and will also briefly introduce the three case studies developed during the workshop and discuss the commonalities and differences in approaches between the three case studies which all used the framework as a starting point.
different mode of action (the chemical pesticide Chlopyrifos, CPF, and the biocide pesticide Bti) in the mosquito Culex pipiens. We expected that the effects of the single exposures are strengthened in the presence of DTV. In addition, we tested whether there is an interaction between CPF and Bti and whether this interaction is magnified in the presence of DTV. We crossed three DTV treatments (no DTV, a small DTV of 7°C and a large DTV of 14°C) with four pesticide treatments (a solvent control, single CPF exposure, single Bti exposure and exposure to the CPF-Bti mixture). We examined the effects on larval body size, population growth rate (r*) and its key components. The experiment was done in three steps: (i) 4-day exposure in L4 to DTV, (ii) 2-day exposure to DTV and the pesticide treatment and (iii) exposure to DTV until metamorphosis. The presence of a large DTV increased the toxicity (based on r*) of the chemical pesticide, but not the biocide. Moreover, a high DTV changed the chemical composition of the CPF-Bti mixture. For example, the presence of large DTV removed the antagonistic interaction effect on total mortality which was present in the absence of DTV and in the presence of small DTV. Our results underscore the importance of considering DTV as a factor instead of only the toxicity of pesticides but also the interaction type between pesticides in mixtures. Given DTV occurs in all natural populations and may strongly differ between latitudes, DTV may be an important factor causing a mismatch between toxicity studies done in the lab at constant temperatures and the toxicity of pesticides and their mixture in the real world.

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Warming and daily temperature fluctuations make the pesticide chlorpyrifos more toxic in Ischnura elegans damselflies

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Current risk assessment of pesticides fails to protect aquatic biodiversity. A key reason is the lack of realism: pesticides are tested under ideal laboratory conditions at one mean temperature. To strengthen current risk assessment it is crucial to incorporate effects of global warming on the toxicity of pesticides. Global warming studies largely overlook that climate scenarios also predict stronger daily temperature fluctuations (DTFs), which can have greater fitness effects for organisms than increases in mean temperatures. While many pesticides (like organophosphates) get more toxic at higher temperatures, it is largely unknown how DTFs influence the pesticide toxicity. We examined a multiple-factor scenario where we quantified the single and combined effects of (i) increases in mean temperature and (ii) in DTF, and (iii) exposure to the pesticide chlorpyrifos (CPF) in larvae of high- and low-latitude populations of Ischnura elegans damselflies. CPF imposed mortality and more so in high-latitude compared to low-latitude larvae. Moreover, CPF was more toxic at 24°C compared to 20°C, confirming the higher toxicity of organophosphates at higher temperatures. A key finding was that DTF also increased the toxicity of CPF, providing novel evidence that DTFs can amplify the toxicity of pesticides. Furthermore, the increased toxicity of CPF by DTF was more pronounced at 24°C. This novel pattern is likely general as at a higher mean temperature, DTF will expose the animals to even higher temperatures during the daily cycle, thereby increasing exposure to stressful temperatures. Also, the negative effect of CPF on larval growth strongly depended on DTF. CPF did decrease larval growth considerably, but only in the 10°C DTF treatment. Probably the higher metabolic demands for cell maintenance in the 10°C DTF treatment resulted in lower growth rates. Our results convincingly show that the organophosphate pesticide chlorpyrifos is not only more toxic to damselfly larvae at the higher mean temperature (24°C) but also at higher daily temperature fluctuations (DTFs). The behavior and life span in terms of survival and sublethal effects (growth rate). Notably, the synergistic effect of DTF on pesticide sensitivity was higher at the higher temperature. Our results highlight that incorporating higher mean temperatures and especially DTFs in ecotoxic testing will increase the realism of the risk assessment of pesticides under global warming.

PBT/vPvB & PBT/vPvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (I)

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RPLC-HILIC and SFC coupled with Mass Spectrometry: Polarity Extended Screening of organic molecules in the aqueous environment

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Trace organic compounds are important in environmental analysis, because they impact water quality and introduce potential (eco)toxicological effects. Current analytical methods mostly rely on gas chromatography (GC) or reversed-phase liquid chromatography (RPLC) coupled with (tandem) mass spectrometry. However, neither method can easily separate very polar molecules. Two chromatographic separation strategies, a serial RPLC- hydrophilic interaction liquid chromatography (RPLC-HILIC) coupling and an analytical scale supercritical fluid chromatography (SFC) system will be presented, and their separation effectiveness as polarity-extended chromatographic methods for 274 environmentally relevant compounds were validated in a recent publication [1]. Compounds tested were grouped into three polarity classes, “very polar” log D (pH 7) below -2.5, “polar” log D (pH 7) between -2.5 and +2, and “non-polar” log D (pH 7) higher than +2. Nearly all compounds could be retained in both systems with relative standard deviations of retention times (RT) (n = 6) typically between 2% and 5%. Both techniques have considerable benefits when combined with accurate mass spectrometric detection. Molecules RT and accurate mass were recorded in a database for each set up. This information was used for compound screening methods for screening purposes like “hidden-target screening” in complex environmental matrices (such as wastewater treatment plant effluent samples). However, high polarity is a necessary to include “very polar” compounds in water monitoring techniques and protocols [11]. S. Bieger, G. Groen, S. Grosse, T. Letzel: RPLC-HILIC and SFC coupled with mass spectrometry: Polarity-extended organic molecule screening in environmental (water) samples. Analytical Chemistry 2017, 89 (15), 7907-7914 (DOI: 10.1021/acs.analchem.7b00859).

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Removal options and transformations of persistent mobile organic chemicals during production of drinking water

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Persistent Mobile Organic chemicals (PMOCs) are well water soluble, non-volatile and are thus mobile in the water cycle. Because of their intrinsic properties, they are able to penetrate natural and artificial barriers and may constitute a threat for drinking water. Advanced treatments like activated carbon and oxidation processes can be used to limit the presence of organic micropollutants in drinking water. However, low removal by activated carbon is expected for PMOCs of their high polarity. The behavior of coal and plant effluents T, Bti mixture. For example, the presence of large DTV removed the antagonistic interaction effect on total mortality which was present in the absence of DTV and in the presence of small DTV. Our results underscore the importance of considering DTV as a factor shaping not only the toxicity of pesticides but also the interaction type between pesticides in mixtures. Given DTV occurs in all natural populations and may strongly differ between latitudes, DTV may be an important factor causing a mismatch between toxicity studies done in the lab at constant temperatures and the toxicity of pesticides and their mixture in the real world.

Removal of polar micropollutants from drinking water by reverse osmosis: a pilot scale study

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The occurrence of polar micropollutants (MPs) in drinking water sources is regarded as one of the most challenging issue of our times. Polar MPs can be removed by adsorption on activated carbon or by reverse osmosis (RO). The objective of this research was to evaluate at lab-scale for their removal by different options including powdered activated carbon (PAC), high pressure membrane processes and transformation by ozone and chloride. High polarity PMOCs such as adamantane-1-amine (Log D = -2.34), trfluormethanesulfonate (Log P = -1.35) and -caprolactam (Log P = 0.15) were not removed by PAC even for very high doses. Only naphthalenesulfonate (Log P = 0.41) was fully removed for 5 mg L 1 PAC. The other PMOCs i.e. aromatic sulfonates, aromatic amines, phenols, were removed significantly for high PAC doses, but that are not compatible with drinking water production. Most of the PMOCs identified in water resources showed a very low reactivity with ozone with rate constants below 100 M s 1 and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-diphenylguanidine and the 1,3-di-o-tolylguanidine, an olefinic sulfonate and an amine compound, the B- benzylidimethylamine, were rapidly transformed by ozone. Transformation of both guanidines occurred in few seconds at neutral pH during disinfection by chlorine. Chlorinated and hydroxylated analogues, and products of cleavage and cyclization were identified. US EPA toxicity prediction tool showed that chlorination and hydroxylation analogues of MOCS were more toxic than the parent compound, which was confirmed by Microtox acute toxicity test for Cl/guanidine ratio of 1 and 10. Thus, reactions with chlorine during disinfection can be a source of new, persistent and more toxic chemicals in drinking water Some PMOCs like -caprolactam, halogenated methanesulfonates, adamantane-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor oxidized by oxidation processes and could thus be present in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.

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Removal of polar micropollutants from drinking water by reverse osmosis: a pilot scale study
RO. Feed water samples were analysed by direct injection, whereas RO permeate samples where enriched by solid-phase extraction. The analysis were carried by ultra-high-performance liquid chromatography coupled to time-of-flight high-resolution mass spectrometry. Neutral polar MPs displayed less than 5% passage, except benzotriazole, tolyltriazole and phenyleurea, which displayed a passage of 25%, 17% and 10%, respectively. The data showed that removal of neutral polar MPs is mainly governed by size exclusion. For neutral and moderate polar MPs the inverse seems to be true. Tighter membrane and multi-stage RO will be investigated to improve the removal of small neutral MPs for drinking water applications.

371 Identification of transformation-derived very polar organic contaminants and their relevance in the water cycle

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Highly polar organic substances are well water soluble, non-volatile, and exhibit only minimal adsorption to nonpolar surfaces. Therefore, they may be able to penetrate natural and artificial barriers and are thus mobile in the water cycle. If these mobile organic contaminants (MOCs) are persistent (POMCs) against microbiological and chemical degradation, their removal during water treatment and drinking water purification may prove difficult. Toxic POMCs can be classified as PBT (persistent, mobile, and toxic) substances. Since the most frequently used trace analytical method for the quantification of organic pollutants in aqueous matrices, reversed-phase high performance liquid chromatography - tandem mass spectrometry (RP-HPLC-MS/MS), is only of limited use for the analysis of very polar substances, little is known about POMCs in the water cycle and only few (e.g. acsesulfame, glyphosate) have been extensively studied and monitored. POMC may be, among others, industrial chemicals, or transformation products thereof. Most transformation processes usually result in the formation of transformation products (TPs) with increasing polarity until either mineralization is achieved or a dead end TP is formed, thus potentially resulting in persistent and highly polar water contaminants. Many POMCs deriving from transformation processes may still be unknown and thus not be represented in suspect or target screening campaigns. As a consequence, no information about their occurrence and origin is available, which severely exacerbates the sophisticated monitoring and effective regulation of their precursors. Based on the work of Arp et al. and Schulze et al. we selected 15 industrial chemicals with a high expected potential to form MOCs and studied their behaviour during hydrolysis, biotransformation, oxidation with MnO2, and photoysis experiments. After structural elucidation of the 9 detected transformation products with high resolution mass spectrometry (HRMS) we developed a qualitative HILIC-MS/MS (Hydrophilic interaction liquid chromatography – MS/MS) method and screened 25 Hessian surface waters for the presence of these TPs. While some TPs were not detected, others were found in an acceptable range. The major screening data provides first information about the potential environmental relevance of the identified TPs, which can be used to prioritize them for inclusion in future quantitative screening campaigns.

372 The limited chemical application domain of regulations: An illustration using the POP screening assessment in the Stockholm Convention

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Regulatory frameworks are initiated by a societal concern and built upon the scientific knowledge existing at the time they are written. This imparts them with a chemical property space in which the frameworks can be applied in the context for which they were conceived and supported by a sound scientific foundation. As time passes, societal concerns change, and this can lead us to want to apply regulatory frameworks outside of their chemical application domain. Today we have the ambition to regulate tens of thousands of chemicals without regulatory frameworks that were in some cases developed 20 years ago with a more modest level of ambition and less scientific knowledge than we have today. Are these regulations really up to the task? This question is explored using the example of the POP screening assessment in the Stockholm Convention. Using perfluorinated alkyl acids (PFAs) and octamethylecyclohexylamine (D4) as case studies, it is shown how this framework can lead to both false negative and false positive conclusions. False negative classification of PFAs can arise because of the inclusion of bioaccumulation as a screening criterion in the framework although bioaccumulation is not a requirement for adverse effects of chemicals in remote regions. False positive classification of D4 can arise because the four screening criteria (persistence, bioaccumulation, long-range transport, and adverse effects) are not valid in the same environmental media/compartments. It is concluded that if we wish to conduct POP assessment for the broad spectrum of chemicals in modern commerce, then we will have to rely less on individual screening criteria and instead apply models that can capture and integrate the broad diversity of chemical behaviour.

373 ‘One for all and all for one’ - Can we REACH a harmonised PBT-assessment across EU-regulatory frameworks?

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Persistent, bioaccumulative and toxic (PBT) substances and REACH are frequently called in one breath. However, also other European regulatory frameworks for chemicals, such as for biocides, plant protection products (PPP), veterinary and human medicinal products (VMP/HMP) stipulate the performance of a PBT-assessment during substance evaluation. As in other hazard based assessments (e.g. GHS/CLP regulation, POP), the PBT/PvB assessment focuses on the properties of a substance only and does neither take into account the use of the substance nor its exposure. Consequently, the identification of a PBT or PvP substance should be independent from the regulatory framework under which it is assessed. However, in our comparison of conclusions on PBT properties for a number of substances falling under more than one legislation it became apparent that the outcome of the PBT assessment does not necessarily correspond between different regulations. This stands in contrast to the goals to perform a comprehensible and consistent assessment of chemicals and to ensure a high level of protection of human health and the environment against hazardous chemicals within the EU. In order to elucidate the reasons still hampering a harmonised PBT-assessment, we did a compilation of a number of technical (amount and quality of data, acceptability of specific data, derivation of endpoints, applied guidance documents), and conceptual criteria (numerical criteria, testing strategy, assessment of transformation products) as well as of other factors (consequences of PBT-assessment, data management and publication of assessment results).

Outgoing from this, we developed several proposals facilitating a harmonised PBT assessment, starting from the implementation of an overall PBT-guidance up to an inclusion of transformation products in the PBT-assessment by all regulatory frameworks. Although it cannot be denied that a harmonisation process is ongoing, we conclude that there are still some fundamental choices to be made both at the organisational level and at policy level first to achieve the goal of a standardised PBT identification among EU legislations.

Product benefits and positive outcomes: valuation and beyond

374 A need for a better characterisation of product benefit in life cycle sustainability assessment

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In life cycle assessment (LCA) the main focus is on damage assessments of the affected activities associated with the product life cycle. However, in order to adequately characterise and evaluate the sustainability of a product, it is necessary to consider the actual functionality of a product. The functional unit is the broad diversity of chemical applications and processes used to serve human needs. Although, the concept of functional unit has been discussed and defined in many ways, it is often unclear how to accurately define this functional unit. The functional unit is different for every product, process or activity. In the first part of this study we therefore further elaborate the functional unit by identifying the product benefits and deriving the holistic sustainability of having the production system instead of a product or service. In order to achieve this goal, we need to define the product benefit as we would reasonably use the product. This includes the benefits and burdens that the product imposes on our society and environment. The product benefit is defined as all of the product’s functions and their corresponding product benefits. The product benefit can be determined through the use of product life cycle assessment (LCA) and its policy support. Three advantages are specified. First, as these functional units are often not specifically defined and a product can have multiple functions, comparison is often impeded in practice. Under the idea of a ‘one for all, all for one’ (a uniform system of classification), a better specification of the functional unit in terms of an aggregated single score for product benefit, such as the net impact on human well-being, would permit to compare all types of products. Second, not only would a better characterisation of the product benefit allow for a better comparison of various production systems, it also allows one to compare the benefit of the product with the damage provided during its production. One can then determine a holistic sustainability system that ensures none of these benefits being lost. Third, when an additional amount of byproduct is created by a production system, this may also induce a byproduct benefit, which can be
375 Assessing nutritional impacts and benefits on human health in LCA: A new midpoint impact category
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Defining a crucial determinant of human health. According to the Global Burden of Disease (GBD), dietary risk factors are responsible for >10 million deaths/year globally. Yet, beneficial and detrimental nutritional health effects, the dominant pathway for health in food systems and diets, are often neglected in Life Cycle Assessment (LCA). To address this, we develop 14 nutritional characterization factors (CFs) for food groups and nutrients using epidemiological evidence from the GBD, and propose a new nutritional midpoint impact category for LCA, demonstrating its application to the entire US diet. We develop marginal nutritional CFs for 8 major food groups (nuts and seeds, whole grains, fruits, vegetables, milk, sugar-sweetened beverages, red meat, and processed meat) and 6 nutrients (omega-3, calcium, polymerunsaturated fats, trans fats, and sodium), identified by the GBD as dietary risk factors. CFs are estimated by coupling age- and gender-adjusted information on outcome-specific incidence rates with risk ratios (RR) and severity factors, measuring positive or detrimental effects in avoided dALY/Y. We also develop a profiling system for 6000+ food items contained in the US that aligns publically available data from multiple databases with risk factor definitions from the GBD. Finally, for 6000+ food items we estimate the Health Nutritional Index (HENI), the total avoided health burden from all dietary risk factors per serving and 100 kcal. Nutritional CFs for food group and nutrient range between ~8 avoided dALY/Y for sodium, up to 57 avoided dALY/Y for omega-3 from seafood. HENI score typically ranges from ~80 avoided dALY/Y/serve for Frankfurter sandwiches to ~50 avoided dALY/Y/serving of nuts and seeds. Absolute HENI scores and ranking of food items vary substantially when using 1 serving or 100 kcal as a functional unit. Unhealthy food groups such as mixed dishes and protein foods with the exception of seafood and nuts and seeds have negative HENI scores primarily due to detrimental effects from processed and red meat, saturated and trans fats, and sodium. Healthy food groups such as fruits, grains, and vegetables excluding starchy vegetables tend to have positive HENI scores dominated by health benefits from their respective food groups. The estimated nutritional CFs for the new midpoint impact category in LCA that would improve human health impact assessment in LCA and allow for a comprehensive assessment of food items and diets.

376 Combining Operational Research and Life Cycle Assessment to optimize the environmental performance of Peruvian diets
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Food production and security has been highlighted as one of the most threatened sectors worldwide due to the effects of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, ~50% of household expenditure is destined to food purchase. In contrast, malnourishment is still rampant in many socioeconomic sectors, mainly in the Highlands in the Amazon basin. In this context, it appears as a major challenge to jointly achieve nutritional improvements in the Peruvian diet and reductions in terms of GHG emissions. Hence, the main objective of this study was to apply a methodology which allowed optimizing the environmental profile of the Peruvian diet while improving its nutritional requirements at competitive economic costs. In other words, the aim of the optimization model was to determine an optimal diet from an environmental perspective considering nutritional and economic constraints. For this, a joint combination of Operational Research and Life Cycle Assessment was performed. Based on the average diets identified for each city included in the study, an optimization was performed considering a set of criteria that respond to the three dimensions of sustainability. Nutritional aspects were included in the model through a restriction based on the minimum consumption of food types and caloric intake recommended by Peruvian authorities. Regarding economic costs, the model included a set of inequations that limited the minimum and maximum monetary changes throughout the year (i.e., 2016). Finally, environmental aspects were considered by introducing an objective function that minimizes the emissions of CO2eq of the entire food basket. The result of the proposed linear program allows understanding the amount of each individual food product that should be consumed in each city that satisfy all the restrictions included in the model in order to attain the lowest GHG emissions possible. AMPL® was used as the programming platform, and CPLEX® as the solver. Results demonstrated that substantial reductions can be attained in GHG emissions through the optimization of diets in Peru. For instance, in Lima the reduction could reach 200 kg CO2eq per person and year (22%). These results constitute an important framework to understand the current situation of the GHG emissions of the average Peruvian diet, as well as to mitigate these emissions while improving nutritional aspects and controlling economic costs.

377 Using the first Swiss dietary survey to determine the environmental and health benefits and impacts of various dietary patterns
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Many studies compare the environmental impacts of dietary patterns such as dietary recommendations (e.g. food pyramids), vegetarian and vegan diets. Mounting evidence suggests diets high in red meat and other animal products have higher associated environmental impacts. A hypothetical non-meat diet is often considered in such assessments, which may e.g. be equi-calorie or mass to the meat containing diet. In this study we use the first Swiss National Survey (MenuCH) to determine what non-meat eaters consume in Switzerland and what potential environmental and health benefits (or impacts) may result from assessing realistic consumption. About 5% of the Swiss population self-identifies as vegetarian, and less than 1% as vegan. Meatless diets contained about the same overall mass of food consumed, generally offered environmental and health benefits through increased fruit and vegetable consumption, but vegan diets can be insufficient in certain essential vitamins if not supplemented. Nuts, seeds, and their oils were important sources of key nutrients such as vitamin E. In conclusion, using dietary surveys can help provide us with evidence as to what we eat. Our study looks into the monetary values of other animal products from the diet. Accounting for the environmental and health benefits of realistic dietary patterns, can help support improved recommendations.

378 The cost of CO2 in Life Cycle Assessment
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Climate change has gained increasing attention over the past decade in response to the revelation that we need to maintain a viable climate for humans and the environment. The increasing emission of greenhouse gases (GHG) such as CO2 may accelerate climate change and cause subsequent damages. Correspondingly, countries and companies actively develop strategies to minimize their GHG emissions and thus climate impacts, but which strategies that will be more beneficial is often hard to evaluate. Life Cycle Assessment (LCA) is a tool to evaluate the damages of GHG emissions from the whole life cycle of the intended strategies, taking a cradle-to-grave perspective. By monetising the impacts related to these emissions, they can be compared to the overall cost of a strategy. This secure that emissions are considered in determining the priority and benefits of the reduction of CO2ex by in situ amendments in soils and sediments. Further, the study looks into the monetary values of GHG, represented by CO2 (or CO2-equivalent), and their underlying cause-effect chains in three Life Cycle Impact Assessment (LCIA) methods LIME2, EPS2015 and ReCiPe2016. The damage cost for CO2 is in the same order of magnitude in EPS2015 and ReCiPe2016, but one order of magnitude higher than that in LIME2. Climate change-related damages on human health are well represented in all LCIA methods, and the monetised damages from this category contribute to more than 70% of the total CO2 cost in all three methods. Social assets and ecosystem damages, on the other hand, are only counted for in two of them. Furthermore, a range of potential socio-economic damages from a changing climate are discussed in IPCC reports, including economic loss from extreme weather events, costs of potential climate-related society security and poverty, but they are not included in any of the LCIA methods. This may limited the suitable application area of the CO2 cost evaluated by LCA, especially in studies where social and economic consequences are the major concerns. The CO2 costs from the three LCIA methods are further evaluated in comparison with approaches from other research fields, such as Social Cost of Carbon (SCC), and discrepancies and associated uncertainties are discussed.

379 Poster spotlight: WE257, WE258, WE259

Advances in monitoring and evaluating remedy effectiveness for in situ amendments in soils and sediments
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Billions of dollars have been spent on environmental dredging projects to remediate contaminated sediments. However, the extent to which this remedy can reduce human health risks is unclear. Environmental dredging projects can alter the chemical, physical, and biological properties of sediments, leading to the release of contaminants. The potential adverse effects are usually not quantified in a manner conducive to comparing them to potential benefits and assessing overall remedy effectiveness. Focusing on the Hudson River PCBs Superfund Site remediation, this study demonstrates a novel approach to comprehensively evaluate the relative tradeoffs between population health benefits and risks associated with different remedial alternatives. The specific aims were to: 1) Assess health impacts on recreational anglers for a No Action scenario, due to bioaccumulation of PCBs in Hudson River fish, and exposure through fish consumption. 2) Determine and compare the reduction in health impact from reduced fish tissue PCB concentrations associated with different remedial options relative to No Action. 3) Investigate potential health impacts of the selected remedy from resuspension of sediment, air emissions of PCBs, diesel particulate matter (DPM) and NOx, and occupational incidents. 4) Compare the avoided health impacts, i.e., the health benefits, with the created health impacts. For each considered impact pathway, we derived both central and upper bound estimates, using the disability adjusted life year (DALY) as a comparative metric. For the No-Action scenario, the health impacts are 11 and 78 DALY for male and female populations, respectively. In comparison, the source control action (MNA) could have achieved a 30% reduction in the total health impact, without the need for substantially more expensive and labor intensive remediation. Potential benefits of MNA are further highlighted when resuspension is an important factor. Furthermore, potential health impacts created by the selected remedy are within the same order of magnitude as potential benefits. Other methods tested to validate efficacy and cost-benefit analysis include a multi criterion decision analysis (MCDA) and the selected remedy scenario. Impacts associated with chemical inhalation exposures are less substantial, albeit not negligible. The quantitative framework of this study, when supplemented with adequate monitoring data, can provide valuable insight into the overall effectiveness of a given remediation in light of alternatives.

381 Six inches under: Remediation efficiency of activated carbon caps buried by dynamic sediment movement
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The use of thin-layer activated carbon (AC) based thin layer caps is a promising and novel in-situ remediation method for contaminated sediments. The method utilizes the adsorptive capabilities of AC, allowing it to strongly bind persistent organic pollutants, thus greatly reducing the contaminants' bioavailability and sediment to water flux. Sediment capping with active materials can furthermore provide a less destructive, low-cost alternative to traditional remediation methods, such as sediment dredging. In this study, the method was reversibly applied in a laboratory setting, with the conditions of the first field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaalanjärvi, a 30 m² plot was amended with an AC thin layer cap (1.6 kgAC/m²). Due to the shallow nature of the lake and its large surface area, highly dynamic sediment movements occurred over the monitoring period of 14 months. As a consequence, the AC cap was buried rapidly under a layer of resuspended sediment leading to a low measurable impact of the AC amendment. Neither benthic community structure nor PCB bioaccumulation in local benthic organisms were significantly different on the AC amended plot and the surrounding reference sites. The amount of sediment deposited was high (34.2 g dry matter/m²/day), making detailed observations on the development of the situation over time difficult. To investigate the potential for a long term remediation success of AC caps even under these unfavorable conditions, a corresponding laboratory study was conducted. The field scenario was replicated in test vessels containing a base layer of PCB contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. The results indicate that an AC cap can remain effective even once it has been covered with contaminated sediment. This depends, however, on the intensity and depth of bioturbation. With the deeper dwelling L.variegatus present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the shallow dwelling C. riparius, this effect could only be observed with minimal sediment coverage of the AC (<5 mm).

382 Ecotoxicology for environmental remediation: the NANOBOND project
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In situ remediation of sludge and dredged harbour sediments is currently highly cost-effective despite an ever increasing number of sites requiring swift treatments to reduce contamination. Therefore there is a urgent need worldwide to identify new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies. This leads to increasing interest in the use of engineered nanomaterials and nanoparticles (ENMP) for environmental remediation, known as nanoremediation, represents a challenging and innovative solution, environmental and human risk assessment associated with the use of ENMP are still a matter of debate. Limited in situ applications to water and soil contaminated remediation sites of data is available on potential benefits and impacts and there is a general demand for strategies aimed to fulfill such needs. As the potential and efficacy of nanotechnologies is well established, several drawbacks related to full-scale application should be overcome. In particular great efforts should be devoted to develop (nano)materials which own ecofriendly features such as limited release and mobility in environmental matrices as well as no toxicity for natural ecosystems. Ecotoxicology can be thus used to develop ecofriendly (nano)materials for environmental application and to provide monitoring methods in a weight-of-evidence approach also to support decision-makers. The NANOBOND project (Nanomaterials for Remediation of Environmental Matrices associated to Dewatering) funded in 2015 by POR CReo FESR Toscana 2014-2020, is developing an innovative system for treating contaminated sludge and contaminated sediments. This new solution, will enable to reduce contaminated sludge and sediments, in terms of volumes and costs of transport, but also to convert the resulting solid and liquid wastes to a renewable clean resource to be use in several other applications. The results of several preliminary trials in which ecotoxicology (bioassay and biomarkers approach) has been applied indicate that the use of nanoparticles is a promising approach to increase the environmental safety (safe-by-design) of nanodeveloped nanostructured materials as well their suitability for in situ application within the geostatexile in terms of environmental impact will be presented.

383 Possibility of using a genotoxic tests in planning precise phytoremediation of depleted soils enriched in organic amendments
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A number of soils at many locations are now considered a problem because of the increase in environmental and human risk assessment associated with the use of organic amendments. The use of genotoxicity tests as part of the risk assessment process are increasingly being considered as a means of determining the safety of organic amendments. The results of several comparative studies have indicated that the use of genotoxicity tests for the assessment of long-term risk associated with the use of organic amendments does not provide any information not already provided by other risk assessment methods. However, the results of these studies also indicate that the genotoxicity tests can be used to determine the likelihood of the occurrence of genotoxic effects in the environment and in humans. The results of these studies have also indicated that the use of genotoxicity tests can be used to determine the likelihood of the occurrence of genotoxic effects in the environment and in humans. The results of these studies have also indicated that the use of genotoxicity tests can be used to determine the likelihood of the occurrence of genotoxic effects in the environment and in humans.

384 Sorption of pharmaceuticals in soil systems
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Pharmaceuticals have been increasingly used worldwide to prevent or treat human and animal diseases and continuously released into the environment (Nicolau et al., 2007). Following treatment, highly mobile and persistent pharmaceuticals tend to release into surface water and groundwater by reclaimed wastewater effluent through surface runoff and subsurface drainage, and subsequently being bioaccumulated to aquatic organisms (Kodešová et al., 2015; Tolls, 2001). Strongly adsorbed pharmaceuticals likely to be retained in the soil matrix, which could result in long-term exposure to aquatic organisms (Kodešová et al., 2015; Tolls, 2001). As a consequence, the AC cap was buried rapidly under a layer of resuspended sediment leading to a low measurable impact of the AC amendment. Neither benthic community structure nor PCB bioaccumulation in local benthic organisms were significantly different on the AC amended plot and the surrounding reference sites. The amount of sediment deposited was high (34.2 g dry matter/m²/day), making detailed observations on the development of the situation over time difficult. To investigate the potential for a long term remediation success of AC caps even under these unfavorable conditions, a corresponding laboratory study was conducted. The field scenario was replicated in test vessels containing a base layer of PCB contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. Endpoints were the growth and PCB bioaccumulation in contaminated sediment topped with an AC layer that was in turn buried by varying sedimentation rates. The results indicate that an AC cap can remain effective even once it has been covered with contaminated sediment. This depends, however, on the intensity and depth of bioturbation. With the deeper dwelling L.variegatus present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the shallow dwelling C. riparius, this effect could only be observed with minimal sediment coverage of the AC (<5 mm).
been detected at fairly high levels in aquatic systems (0.33–61 ng/L), terrestrial environments (0.53–340 µg/kg), and in the tissue of organisms (4.6-23.6 µg/kg in crop tissues, 61-127 µg/kg in terrestrial invertebrates) (Chen and Ying, 2015; Kinney et al., 2006; Pan et al., 2014). Long-term exposure to the residues of pharmaceuticals could pose a risk to the ecological system and exert adverse effects on human health via food chain (Carvalho et al., 2014). Adsorption processes have a decisive role for the environmental behaviors and the ultimate fate of pharmaceuticals (Drilliia and Lyberatos, 2005). However, relatively a few investigations of the sorption of organic compounds at the group level based on the dissociation degree of molecule in soil have been published so far (Droge and Goss, 2013; Franco and Trupp, 2008; Franco et al., 2009; Kah and Brown, 2007). The main aim of this study was to explore the effects of properties of the chemical and soil on the sorption of organic compounds in the soil environment. First, sorption behaviors of nineteen pharmaceuticals across four groups (neutrals, strong bases, weak bases, acids) were explored in five test soils. Using the measured sorption coefficients for each group, we evaluated the applicability and accuracy of existing predictive models that have been proposed to predict the sorption behavior of organic chemicals in soil. Finally, Pearson correlation analysis and Principal components analysis (PCA) have been carried out at the group level to systematically assess the potential factors (both soil and drug properties) influencing the sorption behavior of pharmaceuticals in soil and to get better understandings of the sorption mechanisms of different pharmaceuticals in the soil.

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In vitro and in vivo assays to evaluate chlordecone transfer to animals: interest of soil amendment

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Chlordecone (Kepone) (CLD) is a highly persistent pesticide formerly used in French West Indies. Nowadays high levels of this pesticide are still found in soils which represent a subsequent source of contamination for outdoor-reared animals. In that context, sequestering matrices as activated carbons (ACs) or biochars are believed to efficiently decrease CLD transfer to animals. The present study intends to test using 2 distinct in vitro tests prior an in vivo assay the respective efficiency of several biochars and ACs to limit CLD transfer to animals. The Te-PBET and the ISO/DIS 16 751 availability part A protocols were used. In each test amended soils were prepared from a control one (SS) by adding 2% (mass basis) of one of the ACs or biochar. A selection of interesting matrices was realized prior the in vivo part of the study. For each matrices, 2 biochars were chosen by alimentary route to contaminated soils. Only treatment groups exposed through amended soil with ACs presented significant decreases CLD availability, bioaccessibility (< 8%). Similar results were found using both in vitro assays. At last, concentrations of CLD in piglets liver and adipose tissue were found significantly lower after exposition to an AC amended soil (p < 0.001). This decrease was particularly high for a coconut shell activated carbon where relative bioavailability was found lower than 3% for both tissues. Finally, a positive correlation was found between environmental availability, bioaccessibility tests and in vivo results. This study leads to conclude that (i) AC introduced in CLD contaminated soil should strongly reduce CLD availability; bioaccessibility and bioavailability (ii) Tested biochars showed no reduction of transfert (iii) availability and bioaccessibility tests could be useful screening tests in order to select the appropriate biochar or AC.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (I)

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Determination of dioxin-like polychlorinated biphenyls in land near the dumps of some settlements of the Republic of Armenia

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The sources of environmental pollution with polychlorinated biphenyls along with the energy production/distribution complex include landfills, many of which do not correspond to environmental requirements and are the only attribute of the “consumer” relationship to nature, thus bringing forth a number of problems and a great danger for the normal functioning of biocenosis. In the present research we investigated the problem of the sorption behavior of polychlorinated biphenyls in soils and water basins near some settlements of the Armenia. The following 14 dioxin-like polychlorinated biphenyls (PCBs) were determined in soil samples: congeners NN 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 170, 180, 189. Quantitative determination was carried out using chromatography with electron capture detectors (ECD) equipped with glass capillary column with stable phase DB-5MS UI and the following parameters: 60 m x 0.250 mm x 0.25 µm. Special attention was paid to the total amounts of polychlorinated biphenyls, as the total amount of these compounds correlates with the hygienic standards, which as such are integral values. In all investigated soil samples dioxin-like PCBS were detected, however, in this case we mainly recorded congeners NN 77, 81, 105, 114, 118, and 123, while NN 169 was determined less frequent and at insignificant quantities. Attention was drawn to the following: - out of 7 randomly selected soil sampling sites, a 2 to 3.5 times exceeding of the total/summary standard level was found at four sites; - in all cases, the excess of the standard was due to PCBS NN 81 and 114. Of special attention was the fact that at one of the soil sampling sites (Dilijan Town, Tavush Province of Armenia) along with 3.5-fold exceeding the standard, almost all dioxin-like PCBS were found.

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Associated Health Effects of Veterinary Pharmaceutical Residues in Wastewaters around Selected Livestock Agriculture Farms in Western Cape Province

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Livestock farming is a major industry in the Western Cape Province of South Africa and livestock agricultural farms have been suggested to be a major source of pharmaceutical residues in many aqueous matrices, due to their enormous use. Pharmaceutical products such as steroids and non-steroids hormones, antibiotics and non-steroidal anti-inflammatory drugs from agriculture have been indicated to have the potential to show significant endocrine and other health effects. In this study, a High Performance Liquid Chromatography coupled to ultraviolet detector (HPLC-UV-Vis) method was homologized and validated for the detection and separation of the selected pharmaceuticals in effluents for livestock farms with major activity in the study areas. Multi-residue solid phase extraction (SPE) procedure was developed and validated for the recoveries of acetonaphthohen, dichlorophen(2P), salicylic acid (SA), tetracycline(TC), chloramphenicol(CHR), ciprofloxacin(CP), bisphenol A(BPA), 17β-estradiol(E2), mebendazole(IV) from agricultural wastewater using the hydrophilic-lipophilic balance(HLB) SPE column. Recoveries of the pharmaceuticals from standard aqueous solutions spiked concentrations of between 2 and 10 µg/l were: E2, 78.62 – 85.47 %; AC, 78.29 – 94.34 %, TC, 88.35 – 92.15 %, CHR, 76.62 – 88.35 %; SA, 79.38 – 81.49 %; E3, 85.42 – 92.15 %; BPA, 80.27 – 89.42 %; CP, 76.58 – 90.21 %; DP, 75.46 – 87.55 % and IV, 80.27 – 84.89 %. Various levels of veterinary drugs - AC, < 0.48 – 1.07 µg/l; SA, < 1.37 – 15.49 µg/l; TC, < 3.45 – 4.57 µg/l; CP, < 0.45 – 2.46 µg/l and IV, < 1.74 – 1.63 µg/l were detected in the grab water samples. The results of the health risk assessment clearly showed mutagenic activity being observed in samples from sheep and poultry farms. It also showed high estrogenic activity in the pig farm. The results indicated that making use of the maximum concentration of 17β Estradiol found in the samples, there was a slight risk of developing cancer through accidental ingestion via recreational activities with higher risk if the water was used for domestic purposes without treatment to remove them or if the water was used for irrigation purposes.

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Characterization of respective contribution of agriculture and urban sources to pesticide contamination of a peri-urban river

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Water is nowadays a precious resource on which anthropic pressure increased drastically these last years, due to global lifestyle improvement and the population growth. Pesticides are part of the most prevalent micropollutants in aquatic environments because of their intrinsic toxicity, even at trace-levels. They were firstly used for agricultural yield improvement but they are now used as biocides for the protection of construction materials, wood, textiles, paints, etc., or as veterinary treatment susceptible, and can be discharged in rivers via wastewater treatment plants (WWTP) or Separated Stormwater Overflow (SSO). This multiplicity of uses is linked to high concentrations in rivers, affecting aquatic ecosystems that play role of final receptacle for micropollutants in general. It is thus necessary to consider pesticide inputs to water resources. Treatment of pesticides can be quite expensive and inputs may not be clearly identified or controlled. Their reduction at source can be considered as an interesting alternative (dose reduction, practice changes, etc.). However this approach requires first of all the identification of uses responsible for inputs, as few information is available nowadays. This study monitored for 4 years a peri-urban continuum formed by a river, SSO and a WWTP as well as wastewaters to link uses and presence in environment. Water bodies presented distinct contaminations profiles: rivers were characterized by important concentration of plant protection products while WWTP effluents presented important concentrations of biocides and veterinary molecules which are among the most toxic pesticides. Flux calculation allows identifying agriculture as the major source of plant protection products while WWTP brought the most part of biocides and veterinary products, especially in low-flow period when the WWTP contributes up to 40% to the overall flow of the studied river. Storm sewers had an intermediate status, with less consequents inputs but are still significant because of lack of treatment on these effluents and a potential increase of concentration around the
discharge site. Investigation in the wastewater network identified uses responsible for introduction of some molecules like fipronil or glyphosate which is essential in order to implement actions of reduction at source.

389 Study of bioconcentration of benzophene-3 in gilt-head Bream and characterization H. Ziarrusta, L. Mijangos, University of the Basque country UPV/EHU / Department of Analytical Chemistry; R. Montes, University of Santiago de Compostela; R. Rodil, University of Santiago de Compostela; J. Quintana, University of Santiago de Compostela; E. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; U. Iaguirre, University of the Basque Country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; N. Etxebarria, M. Olivares, O. Zuloaga, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry

Benzophene-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation, and owing to its hydrophobic properties, it could potentially bioaccumulate in aquatic biota, including fish (tens to thousands of ng/g). BP-3 can undergo both photodegradation or phase I and phase II metabolism, generating transformation products and metabolites.

Environmental risk assessment approaches often require information on the free concentration in water, bioaccumulation factors in aquatic organisms, by-products and their toxicity in order to determine the effect of a contaminant on ecosystems. Thus, in the present work, in order to assess the uptake, distribution in different tissues (liver, muscle and gill) and bio-fluids (plasma and bile), metabolism and elimination of BP-3 in gilt-head bream (Sparus aurata), a controlled dosing 14-day experiment was designed at 50 ng/mL concentration level. BP-3 was detected in all the analysed samples, with the highest concentrations at day 14. Bile concentrations were found to be significantly higher in comparison to the rest of tissues/fluids. Since BP-3 is hydrophobic and non-ionic compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipidic) could be an appropriate reservoir of BP-3, the low concentration of non-metabolized BP-3 found in this tissue could indicate a high metabolization activity in liver. And on the contrary, the lack of biodegradation activity in muscle (less lipidic) can explain the second highest concentrations detected, reaching the equilibrium state in the 4th exposure day. In any case, the occurrence of BP-3 in gills suggests that at least part of the uptake occurred through the gills. To completely characterize BP-3 exposure, the analysis performed by means of liquid chromatography – high-resolution mass spectrometry allowed the identification of a broad suite of BP-3-by-products in seawater and fish tissue/biofluids (mainly in bile and liver). By the interpretation of the MS2 spectra, we identified demethylated, hydroxylation and glucuronidation as the main degradation pathways of BP-3. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the projects CTM2014-56628-C3-1-R and CTM2014-56628-C3-2-R, Xunta de Galicia (ED431C2017/36) and FEDER/ERDF. H. Ziarrusta is grateful to the Spanish Ministry of Education and L. Mijangos to the Basque Government for their predoctoral fellowships.

390 Phragmites australis enantioselectively uptake, translocate and degrade the chiral pesticides tebuconazole and imazalil L. Mijangos, Nottingham School of Animal, Rural and Environmental Sciences; P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; M.E. Casas, Aarhus University / Department of Environmental Sciences; U.E. Bollmann, Aarhus University / Department of Environmental Science; C.A. Arias, H. Brix, Aarhus University / Department of Biosciences; K. Bester, Aarhus University / Department of Environmental Science

Phytoremediation is an emerging technology that utilises green plants and their associated rhizosphere microorganisms to clean polluted environmental media. However, the role of plants in removing organic pollutants is still not well understood. Phytoremediation of realistic environmental concentration (10 μg L-1) of the chiral pesticides tebuconazole and imazalil by a wetland plant, Phragmites australis, was investigated. The experiment was carried out in a growth chamber using plants of similar initial size (6.0 ± 0.2 g fresh biomass). The plants were placed in 700 mL glass vessels containing 500 mL hydroponic solution. The pesticides were spiked separately (n=27 for each) in parallel with control samples (n=15). The experiment ran for a period of 24 days. Enantioselective fractions and translocation products (TPs) in both hydroponic growth solutions and in plant tissues were measured by HPLC-QTOF-MS. The uptake, translocation and metabolism of tebuconazole and imizalil inside Phragmites australis were documented for the first time using enantioselective analysis. The pesticides removal efficiencies from water were 96.1% and 99.8%, respectively, by the end of the experiment (day 24). Removal from the solutions could be described by first-order removal kinetics (k=0.14 d-1 for tebuconazole and k=0.31 d-1 for imazalil). Four different processes occurred simultaneously: 1) removal of the pesticides from the hydroponic solution, 2) plant uptake, 3) pesticides translocation in the plant, and 4) degradation within the plant. Tebuconazole and imizalil concentrations inside Phragmites showed a maximum level at day 10 and 5, respectively, followed by a decrease of both compounds concentration. Two TPs of tebuconazole could only be quantified in solution, while two imazalil TPs were quantified in both solution and plant tissue. The uptake of both pesticides by the plant was positively correlated with evapotranspiration. The removal of imizalil and tebuconazole from the hydroponic solution was not enantioselective, however, both translocation and degradation inside Phragmites were enantioselective. For tebuconazole, the enantioselective degradation was found in both Phragmites roots and shoots.

391 Effects of the non-steroidal anti-inflammatory ibuprofen on growth and metabolic profiles of Vigna Unguiculata Y. Pico, University of Valencia / Medicine Preventive; R. Alvarez-Ruiz, University of Valencia; L. Wijaya, A.H. Alfarh, M. Alyemeni, King Saud University; D. Barcelo, IIBQ-BSCIC / Department of Environmental Chemistry

The non-steroidal anti-inflammatory ibuprofen is one of the most frequently detected pharmaceuticals in wastewater treatment plants. Its metabolism has been widely studied in mammals, fungi and microbes. However, little is known on how ibuprofen is metabolized by plants, mostly due to analytical methodology gaps for determining these compounds at low concentration in complex matrices. In this study, the effects of ibuprofen treatment on the growth and its comprehensive metabolic profile in whole plant cultures and seed germinates of Vigna unguiculata were investigated using ultra-high performance liquid chromatography quadrupole time-of-flight mass spectrometry (UHPLC-QTOF-MS). To this end, the developed method achieved simultaneous quantitative analysis of ibuprofen, 1 and 2-hydroxyibuprofen and carboxyibuprofen while preserving the instrument ability to get precursor and product ion mass spectra of non-target compounds. The trigger was the precursor ions to reach 100 cps intensity. Seeds of V. unguiculata were obtained from Giza area of Saudi Arabia, were germinated in Petri plates or sown in pots, two different germinated treatment regimen (control, 400 ppm and 5000 ppm of ibuprofen). Seeds and plants were incubated in a growth chamber in the dark at 26 °C for 5 days. Forty-six metabolites of ibuprofen in V. unguiculata were successfully identified. The 1-hydroxy and 2-hydroxy ibuprofen were confirmed and quantified using their analytical standards. The structures of the other metabolites were proposed using high resolution mass spectrometry (HRMS) and high resolution tandem mass spectrometry (HRMS/MS) data. In particular, the combination of mass accuracy and the fragmentation patterns of metabolites and parent compounds allowed proposing plausible structures for each metabolite. Six hexosides were already reported in study on Phragmites australis and Lemma gibba. Thirty-eight of the identified metabolites were already reported in a study on certain cultures of A. thaliana and 9 of them (conjugates of ibuprofen or hydroxyibuprofen with amino acids) are, up to our knowledge, reported for first time in plants.

Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (I)

392 Environmental Risk Assessment of Active Pharmaceutical Ingredients used in Human Medicinal Products: Europe-wide Variation in Risk Quotient J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; S. Owen, AstraZeneca / Safety Health Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; B. Verbruggen, University of Exeter; L. Gunnarsson, University of Exeter / Biosciences This presentation will describe the total consumption-based environmental risks posed by 130 human medicinal products and the impact of mode of action, lipophilicity and dilution on these risks. In accordance with Article 8(3) of Directive 2001/83/EC, as amended, a new marketing authorisation application shall be accompanied by the evaluation of the potential environmental risks posed by the human medicinal product. These environmental risk assessments (ERAs) estimate the potential environmental impact on a product-by-product basis rather than a substance-by-substance basis. In the cases where an active pharmaceutical ingredient (API), or substance, is used to treat multiple clinical diseases, there is the potential to under-estimate impacts. In addition, the European Medicines Agency (EMA) guidance for the environmental risk assessment of human medicinal products has been in place now for over 10 years. The introduction of this guidance marked a step change in the ERA requirements for human medicinal products, with a shift from short-term acute to long-term chronic environmental effects assessments, and tailored ERAs for active pharmaceutical ingredients (APIs) with suspected or known reproductive effects. To determine the total substance or API risk, we have: (i) identified and collected definitive published no observed effect concentrations (NOECs) for available APIs (excluding anti-infectives and anti-parasitic products); (ii) collated human consumption data for each of these APIs in European Countries where these products are licenced for use; (iii) conducted a worst case exposure assessment (predicted environmental concentrations (PEC) and estimated environmental concentrations (EEC)) and (iv) assessed the variability in the risk quotients (RQs) for each API across Europe and (v) looked at the impact of country-specific dilution factors applying the 5th percentile and
393 Estimation and prioritization of hospital API emissions
A.M. Ragas, Radboud University / Department of Environmental Science; C. van Langen, M. Galpen, K. Tipater, Radboud University; R. Oldenkamp, Radboud University / Environmental Analytical Chemistry, Center for Applied Geoscience, University Hospitals and Academic Research Centres in the Netherlands

Hospital APIs in the environment have been acknowledged as an emerging environmental problem requiring scientific and regulatory attention. A crucial step in environmental risk assessment of APIs is the estimation of their environmental exposure potential. Since there are currently more than 4,000 different human APIs in use, monitoring individual APIs is practically impossible. The aim of the present study was to develop a method for the estimation of the total environmental concentration of APIs based on country-specific per capita consumption data. The starting point for modeling the environmental fate of APIs is country-specific per capita consumption data. Subsequently, the modeling chain follows the steps of excretion into the sewer system, transport to and fate in WWTPs, emission into surface waters and, finally, environmental transport, partitioning and degradation. Unique features of the model include the extensive location-specific information about European WWTPs, the flexibility in modeling Europe’s hydrology and accounting for ionizing properties of APIs. The model was validated using several studies reporting API concentrations in the Rhine basin. API-specific data and characteristics (e.g. physicochemical properties and consumption data) were obtained from the literature. Site-specific and API-specific measurements were directly compared to estimated water concentrations at the relevant locations in the river network. From the results shown for the Rhine basin and preliminary results of some additional basins, it can be concluded that estimations can be made with great spatial and quantitative accuracy. However, model performance depends on factors such as the allocation of country-specific consumption over relevant WWTPs, accuracy of the estimated hydrology, provided consumption data and API-specific characteristics.

394 Development and validation of a model to predict concentrations of human APIs in European surface waters
R. Oldenkamp, S. Hoeks, V. Barbarossa, M. Cengiz, Radboud University Nijmegen / Department of Environmental Science; L. Carter, University of York / Environment Department; E.E. Burns, University of York / Chemistry; J. Wilkinson, The University of York / Environment Department; E. Burns, University of York / Chemistry; J. Wilkinson, The University of York / Environment Department; E. Burns, University of York / Chemistry; J. Wilkinson, The University of York / Environment Department; E. Burns, University of York / Chemistry

Active Pharmaceutical Ingredients (APIs) are consumed in large quantities, and end up in the sewer system using passive samplers with speedi²k as absorbent. The samplers were deployed over a 10-12 day period and analyzed in the laboratory using LCMS. Most of the estimated loads were within a factor of 10 of the measured loads. On average, estimations for Hospital 2 were more accurate than for Hospital 1, which was probably due to the use of monthly purchase data and some other small model improvements implemented for Hospital 2. APIs which are typical for hospitals (e.g., antineoplastics and contrast media) were relatively well predicted. The prioritization of the APIs based on environmental impact was substantially influenced by the availability and interpretation of toxicological data. Diclofenac ranked highest, but this ranking was determined by one particular toxicity study of which the validity is being disputed. Ciprofloxacin consistently ranked high, and to a lesser extent also paracetamol and metoprolol. Azithromycin and isopelrol also ranked relatively high, but only limited toxicity data were available for these substances, resulting in large safety margins.

395 Occurrence and fate of the antiabetic metformin and its transformation products
S. Tölder, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tuebingen / Analytical Environmental Chemistry; C. Zwiener, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tuebingen / Geosciences

Effluents of municipal wastewater treatment are major entry pathways for pharmaceuticals and their transformation products (TPs). A wide-spread compound is the antiabetic drug metformin (MF) with its well-known main metabolite guanyl urea (GU). GU is formed in WWTPs. So far, no other TPs of metformin are reported in the water cycle. In this study, electrochemical experiments for simulation and identification of potential new TPs of MF were performed. In addition we investigated the occurrence and fate of MF and its TPs in WWTP and surface water. Analysis was performed by LC-high-resolution-mass-spectrometry (HRMS) using HIICL (hydrophilic interaction chromatography) as the quadrupole-time-of-flight mass spectrometry (QTOF-MS). Four TPs of MF have been identified after electrochemical degradation. The proposed structures are 4-amino-2-mino-1-methyl-1,2-dihydro-1,3,5-triazine (4,2-AMT), 2-amino-4-methylamino-1,3,5-triazine (2,4-AMT), 2,4-diamino-1,3,5-triazine (2,4-DAT) and methylbiguanide (MBG). The mass error was below 3 ppm for all 4 TPs. However, the well-known TP GU could not be formed electrochemically. The TPs found are similar to those of a former study using gamma radiolysis (Collin et al. 2004). 24-hour mixed samples of wastewater in Southwest Germany were obtained for 7 consecutive days. Elimination of MF was 92 % at an average influent concentration of 24 µg/l. GU concentrations were in the influents between 66 and 640 µg/l and in the effluents between 60 and 386 µg/l. A plausible reason for the occurrence and relatively high concentrations of GU compared to MF could be the formation of GU already in parts of the sewer system. The following oxidation products of MF have been detected for the first time: 2,4-DAT, MBG and 2,4-AMT. The concentrations of MBG ranged between 40 and 122 ng/l. For the other TPs no authentic standards were available, however TPs 2,4-DAT and 2,4-AMT showed similar mass spectrum to that of the metformin effluent samples, which implies their formation during WWT. 3 grab samples of surface water affected by waste water showed relatively high MF (between 100 and 470 ng/l) and GU (between 3700 and 4500 ng/l) concentrations. MBG was in the range between 10 and 30 ng/l. In addition, 2,4-DAT was detected. Its response was in all three samples about 40 % of the response of the WWTP effluent samples. The study is performed within the project “Effect-Net”, funded by the Ministry for Science, Research and Art, Baden-Württemberg.
The University of York / Natural and Built Environments; R. Ashauer, University of York / Environment Department
The majority of active pharmaceutical ingredients (APIs) currently in use are ionisable and may become charged at environmentally relevant pHs. Previous research has shown that the accumulation of a molecule in aquatic invertebrates depends on the ionisation state of the molecule which is driven by the pH of the surrounding medium. Recently a toxicokinetic modelling approach has been proposed to account for this variation in relation to pH. Here, we present this modelling approach to derive toxicokinetic parameters from laboratory experiments for the accumulation of amitriptyline, an antidepressant compound, in *Lumbriculus variegatus*. Toxicokinetic (TK) parameterisation and the underlying experiments involved the measurement of uptake of amitriptyline into *L. variegatus* at four medium pHs (5.5, 7, 8, 9). To simulate accumulation at the landscape scale, we used the generated toxicokinetic parameters in combination with measured monthly concentrations of amitriptyline in river water and associated water pHs obtained from a one year long monitoring study along the two rivers (rivers Ouse and Foss) in the City of York, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Data for two intermediate pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation at the two intermediate pHs revealed that the approach underpredicts the actual accumulation by a factor of 2-4. Predictions of internal concentrations of amitriptyline in *L. variegatus* varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Foss (which had a concentration range of 0.52-2.96 pmol/g and a pH range of 7.6-8.45) than the river Ouse (which had a concentration range of 0.29-2.95 pmol/g and a pH range of 7.41-8.44) and accumulation increased during the course of the year. Even though the model underestimated the internal concentrations by a factor of 2 and 4 in laboratory experiments conducted at pH 7 and 8 respectively, the general approach worked reasonably well to obtain internal concentrations. This study revealed important insights into the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.

**Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress**

**398 Waterplants in Risk Assessment - Selection of Potential Plant Species - Impact of Different Test Guidelines**
G. Cuvigny, Eurofins Agrosciences Ecotoxicology GmbH
When results of standard laboratory tests show an unfavorable high risk, aquatic higher tier tests are needed to reduce uncertainties. In case there is a high risk for aquatic plants additional species could help to reduce these uncertainties for risk assessment by performing Species Sensitivity Distribution (SSD) tests. However, it is not clear which criteria are used for selection of test species and which guideline is most appropriate for such species. Most tests were performed based on the Lemu guideline OECD 221, the two *Myriophyllum spicatum* guidelines OECD 238 and OECD 239, the ASTM E1913-04(2012) for *Myriophyllum sibiricum*, *Sediment contact test with Myriophyllum aquaticum* (ISO/DIS 16191) and the principles of the method proposed by the AMRAP (*Aquat. Macrophyte Risk Assessment*) and the OECD guidelines (Knaebe et al. 2013). Differences between the proposed test protocols for the experimental macrophyte Glyceria maxima was presented by Jo Davies et al. In addition a high number of forms and reactions of water plants could be observed during several years of testing. Some scenarios will be given and an introduction in the complexity of water plant testing for risk assessment will be provided. The focus will be to generate a robust test design which is applicable for most of the water plant species. A proposal for a test design in accordance to the existing guidelines and testing protocols adapted to a broad range of test species will be presented. Based on the EFSA opinion, designs will be discussed and an overview will be given how the test designs can be further adapted to provide a refined risk assessment.

**399 Applying the EFSA Scientific Opinion on NTPP: Testing non-crop species and the reproductive capability of selected species under greenhouse conditions**
Agriculture is the dominating land-use of the EU member states by covering nearly half of the surface area. Using herbicides to reduce weed competition in agricultural areas can adversely affect non-target terrestrial plants growing at field margins. According to the recent EFSA Opinion for non-target terrestrial plants (2014) one important goal is maintaining the biodiversity of plant species in the agricultural area. It is therefore recommended to include also non-crop species in the testing scheme from the list provided in OECD Guideline 208 and 787 and to assess the life-cycle with flowering and seed production. The objective of this study was to assess the viability of generative traits of non-crop species for risk assessment. For this purpose generative traits were evaluated if they provide more relevant information for the risk assessment. For this purpose they were compared with the vegetative traits, such as mortality and biomass production, which are currently assessed in the OECD guidelines 208 and 227. The selected non-crop species are included in commercially available seed mixtures for flower strips. Our experimental design consists of one control and four different herbicide application rates, with 6 replicates. The field rate was assessed at the highest tier. The study involves visual effects and phytotoxicological effects. The number of flowers and plant height were assessed for selected species to evaluate differences in development and flowering. In addition, seeds were sampled to evaluate differences in seed quantity and quality. Furthermore, the results will be compared to a non-target terrestrial plants pilot field study (Knaebe et al. 2017). Presentation (SETAC Europe 2017). References: EFSA PPR Panel (2014). Scientific Opinion addressing the state of the science on risk assessment of plant protection products for non-target terrestrial plants. EFSJ Journal 2014;12(7):3800, 163 pp. OECD (2006). Test No. 208: Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test. OECD Publishing, Paris. OECD (2006). Test No. 227: Terrestrial Plant Test: Vegetative Vignor Test. OECD Publishing, Paris.

**400 Predicting plant community level effects of herbicides based on monoculture dose-responses: Testing the plant community model IBC-grass with experimental data**
L. Dorn, University of Potsdam / Plant Ecology and Nature Conservation; S. Hein, Bayer AG / Effect modelling; C. Milhan, Bayer CropScience AG / Ecotoxicology; T. Preuss, Bayer AG / Environmental Safety; F. Jeltsch, University of Potsdam
Ecological models are rarely found in terrestrial plant ecotoxicology and risk assessment. Especially on community-level, the number of suitable plant models is scarce. Existing models are often not validated with experimental data, although validation is an important step towards their credibility for risk assessors. Nevertheless, ecological models are a suitable tool to extrapolate individual-level greenhouse experiments to the plant communities in the off-field. Especially bearing in mind that protection goals for non-target terrestrial plants as defined by EFSA are on population and community level. Reuter and Siemonet-Gast (2007) performed an experiment that includes not only the test of monocultures but also the test of small artificial communities consisting of 6 different plant species. This study is suitable to be coupled and compared to a plant community model, since it covers the population as well as the community level. We adapted the plant community model IBC-grass to the settings of the empirical study by Reuter and Siemonet-Gast (2007). Specifically, we analyzed to which degree the model is able to represent realistic community level effects not only by comparing visual patterns but also by calculating model adequacy and reliability as a measure for the model fit. The predicted effects of the model IBC-grass show a good agreement with the experimental data, for the monocultures as well as for the communities. Model adequacy was lower in the monocultures. However, model adequacy increases in the communities. In general, model reliability is high in the monocultures and experimental community setup if the effect of the selective herbicide is simulated. Population level and community level effects on plant biomass predicted by the plant community model IBC-grass were in good agreement with the measured effects from the experimental study of Reuter and Siemonet-Gast (2007). This agreement indicates the model is able to reasonably represent intra- and interspecies competition and predict community level effects based on dose-response data. Therefore, the model can serve as an important tool for predicting potential impacts on natural environments with information obtained from greenhouse studies on individual species.

**401 Use in risk assessment of recovery in plants from exposure to chemicals**
T.A. Springer, EAG Laboratories / Specialist Projects & Histology; H.O. Krueger, EAG Laboratories / Aquatic, Plant and Insect Toxicology; J.W. Green, DuPont / Data Science and Informatics
The plant interest group of SETAC has a committee working on validation of ecological models is an important point in the validation of models. Model validation is an important point in the validation of ecological models. Model adequacy is high in the monocultures. However, model reliability is high in the monocultures and experimental community setup if the effect of the selective herbicide is simulated. Population level and community level effects on plant biomass predicted by the plant community model IBC-grass were in good agreement with the measured effects from the experimental study of Reuter and Siemonet-Gast (2007). This agreement indicates the model is able to reasonably represent intra- and interspecies competition and predict community level effects based on dose-response data. Therefore, the model can serve as an important tool for predicting potential impacts on natural environments with information obtained from greenhouse studies on individual species.
complicated by seasonality, changes in nutrients, recolonization, competition, and other factors. Terminology and methodology need to be standardized if the concept of recovery is incorporated into evaluations of chemicals. For some plant types and properties, recovery is contingent upon the timing and duration of exposure and extent of injury. In such cases, the definition of recovery must specify timing and duration of exposure in the operational definition. Examples of recovery in laboratory studies for algae, lemmna, and myriophyllum studies will be presented as well as results from mesocosm studies. Statistical procedures and experimental designs will be presented for these examples and interpretation of results will be discussed.

402 Aquatic primary producers and plant protection products: endpoints and level of protection achieved in the first tier of the risk assessment scheme S. Druquesne, UBA, Federal Environment agency; L. Hoenemann, S. Matezek, M. Solé, K. Swarowsky, German Environment Agency UBA; J. Wogran, German Environment Agency UBA / Department IV plant protection products

In the risk assessment for aquatic primary producers exposed to plant protection products (PPP), the endpoint (EP) corresponding to 50% inhibition of growth (EC50) is used in the first tier. The EC50 can be expressed as inhibition of the average specific growth rate (ErC50) or as reduction in biomass, calculated from yield (EyC50) or as the integral under the growth curve (EbC50). The lowest available EP among ErC50, EbC50 or EyC50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use ErC50s since it is a more robust endpoint. However, it is not yet clear if the protection level achieved is sufficient. This work shows that this new approach (i.e. selecting ErC50) shifts the thus of conservatism of a factor of 6.9 and 3.5 for algae and Lemma sp, respectively. It also shows that the level of protection achieved for primary producers becomes insufficient in 59% of the cases, since the Tier 3 Regulatory Acceptable Concentrations (RACs) from micro-/mesocosm studies (considered as surrogate reference Tier) are lower than the Tier 1 RACs from standard toxicity tests. The results demonstrate that the intended level of protection is currently reached in only 41% of the cases versus 69% of the cases previously. In addition, this work explores which combination of EC50, (EC50 as so etc.) and assessment factor would ensure an adequate level of protection. Recommendations are provided for an optimization of the risk assessment.

403 Poster spotlight: WE152, WE153, WE154

Environmental monitoring of contaminants using terrestrial ecological biomonitor

404 Persistent Organic Pollutants in Germany: Results from the 2015/2016 moss and other species sampling A. Dreyer, Eurofins GFA GmbH / Air Monitoring; S. Nickel, University of Vechta / 2; J. Koschorreck, Umweltbundesamt; W. Schröder, University of Vechta / 2

This presentation aims at reporting on the determination of selected POPs in eight moss samples from Germany within the framework of the 2015 European moss survey and comparing the respective results with such derived for leaves and needles collected for the German Environment specimen bank (ESB). The moss samples were collected in areas located in the vicinity of tree sampling sites from the ESB in full 2016. Deciduous tree leaves and coniferous shoots were sampled in 2015 or 2016 according to the ESB protocols. Overall, 17 polychlorinated dibenzo dioxins and furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluorooalkyl substances (PFAS), 3 isomers of hexabromocyclododecane (HBCD), 7 polychlorinated biphenyls (PCB), 24 brominated diphenyl ethers (PBDE), and 21 alternative halogenated flame retardants (HFR) such as Dechlorane Plus were determined. Except for PCBs and PFASs, POPs of all substance groups could be quantified, although to different extents. Concentrations of individual PAHs and HFRs were in the same order of magnitude as those observed in coniferous shoots or deciduous tree leaves from nearby located areas. Highest levels of PCDD/F, dl-PCBs, HBCD and PAH in moss were observed at sites close to the Belauer See (Northern Germany, agricultural land-use) and the Harz National Park. Concentrations of PBDEs were highest at the two sampling sites in Saarland (conurbation) and at the Harz site. Concentrations for Dechlorane Plus were highest at the Harz site followed by sites located at Soding (forestry) and Scheer (agricultural) and were lowest at the site in the Halle-Leipzig conurbation. Thus, surrounding land-use does not seem to be the (only) driving force determining the POPs burden in moss samples. PBDE moss concentrations observed in this study were similar to those observed at background sites in Spain and lower than those of background/remote sites in Norway. Concentrations of Dechlorane Plus were more than a factor of 100 higher than moss concentrations reported for Svalbard (Arctic Norway).

Mapping percentile statistics of element concentrations in moss collected from 1990 to 2015 in forests throughout Germany W. Schröder, S. Nickel, University of Vechta / 2

Monitoring and mapping of atmospheric deposition can be achieved by use of chemical transport models, sampling developing devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss blights have been set up at 7300 sites in Europe. Environmental monitoring of atmospheric deposition in moss sampled in forests across Germany is in the focus of this paper. Thereby, element- and survey-specific as well as heavy metals and surveys integrating statistical evaluations and GIS-mapping were performed. Cr, Hg, Sb and Zn show, contrary to Fe and Pb, no constant decrease of element concentrations, but an intermediate increase between 2000 and 2005, which did not continue until 2015. Al, As, Cd, Cu and V stagnated between 2000 and 2005, Hg from 2005 to 2015. Therefore, Cr, Sb and Zn will be focused in this paper together with Cd, Hg, Pb and N which are of priority according to the Convention on Long-range Transboundary Air Pollution. Survey-specific statistical analyses corroborate that the spatial patterns of element concentrations in moss are changing across time. The long-term information on the percentile statistics of bioaccumulation of atmospheric deposition in moss is essential for further scientific evaluation as well as for measurements and reporting of nature protection and environmental management.

406 Heavy metal and nutrient concentrations in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geochemistry J. Franzaring, A. Fangmeier, University of Hohenheim / Institute of Landscape and Plant Ecology; L. Paoli, University of Siena / Dept. of Life Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; S. Schlösser, University of Hohenheim / Core Facility Hohenheim: E. Menzel, University of Siena / Dept. of Environmental, Earth and Physical Sciences

Passive biomonitoring is being used for many years to assess changes in the state of the environment. Existing programs make use of international, national, regional and local monitoring networks addressing the effects of the widespread deposition of air pollutants and eutrophying compounds and the accumulation of these in e.g. forest and agricultural ecosystems. This study [1] investigates the effects of increased food consumption. However, plants differ in the uptake of essential and non-essential inorganic elements and organic pollutants and the accumulation varies over time and space mainly due to the different geochemistry and climates in different regions. Here we report on the results of a biomonitoring study using holm oak (Quercus ilex L.) and two pine species (Pinus nigra J. F. Arnold and P. pinaster Ait.), i.e. evergreen deciduous and coniferous species. Samples were collected from Mount Amiata and Monte Dell’Ametamea. Holm oak leaves and needles were sampled at different locations in the Mount Amiata and Colline Metallifere in spring 2017 and the samples consisted of three age classes. While half of the analyses were performed on unwashed samples, the other half rested on samples that were thoroughly rinsed with deionized water prior to the analyses. ICP-MS, ICP-OES and CNS elemental analyses were applied for the determination of Cu, Al, Ba, Cr, Ni, V, Fe, Hg, P, K, Mg, As, Pb, Cd, Zn, N and S. Apart from the significant differences in element concentrations and patterns between the tested species, regions and sites, differences between the washed and unwashed samples was less pronounced indicating that deposition of dust does not play a great role in the area. On the other hand, our preliminary analyses showed significant differences in elemental concentrations between different age classes, which relate to the availability, translocation, accumulation or growth regulation of plant essential and non-essential elements. Multi-element analyses and nutrient ratios can serve to differentiate between the characteristic geochemical and species-specific patterns and the positive derivation from these patterns points to the exceedance of element levels due to pollution and eutrophication. Biomonitoring in post-mining areas serves to identify pollution hotspots and can be used as a key component in controlling the success of land reclamation for agriculture and sustainability.
Bats are excellent ecological indicators owing to their long life span, global distribution, and predictable responses to environmental stressors. Bats play important roles in pollination, seed dispersal, and insect population control and thus it is important to determine whether bat diets change over time as a result of exposure to contaminants such as metals. Bat guano deposits associated with contaminant exposure in relation to the onset of the Industrial Revolution, a period characterized by an increase in atmospheric emissions of metals owing to increased mining and production. Lastly, we present the decrease in $^{226}$Ra within the bat guano deposit in association with the introduction of leaded gasoline.

408  
**Perfluoroalkyl substances and metallic elements in south african dragonflies**

H. Breitman, North-West University / Unit for Environmental Science and Management; V. Lesch, North-West University; Y. Shibata, National Institute for Environmental Studies / Fellow; A. Kinoshita, National Institute for Environmental Studies

Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metallic elements has been published. Dragonfly larvae are present in both pristine and polluted environments and have been used extensively to assess pollution because of their relatively small body size. However, dragonflies are able to bioaccumulate metals during its lifetime that must be better assessed in future research.

409  
**Bioavailability of arsenic and antimony co-contamination to vegetable crops in agricultural soils**

L.P. Erdélyi, University of Wollongong / School of Chemistry; A. Holland, La Trobe University / School of Molecular Sciences; T. Collin, University of Wollongong / School of Molecular Sciences (Australia) (Antimony (Sb) is an emerging contaminant that is associated with behavior in a similar way to arsenic (As). Sb and As often co-occur because of mining. Bioaccumulation and phytotoxicity of As is well studied, but there is little evidence on Sb and its interactive effects with As. Metalloid accumulation in agricultural soils may present health risks and hazards to humans and ecosystems through direct ingestion or contact with contaminated soil and food, a reduction in food quality and safety and disturbance and loss of ecosystem function, a decrease in marketability). The obtained results showed the possibility of using dragonflies as environmental archives that preserve valuable information on interactions and contaminants which allows for the determination of historical exposure to contaminants as well as any fluctuations in diet. This research provides the rare opportunity to examine two bat guano deposits from Jamaica: bat guano was heavily mined for gun powder and fertilizer and as such, there are few bat guano deposits that have been unaltered by human exploration or exploitation. The objective of this research is to reconstruct historical changes in diet and contaminant exposure to bats in order to better understand how anthropogenic activity affects these high trophic level mammals. We constructed the $^{210}$Pb, $^{137}$Cs, and $^{14}$C dating profiles in both bat guano deposits: this revealed that one of the deposits is over 3,000-years-old. We constructed the $^{222}$Rn, $^{210}$Pb, and $^{137}$Cs profiles in order to determine the long-term dietary trends in the bat guano deposits.

410  
**Transcriptomic responses of the endangered freshwater mussel Margaritifera margaritifera to trace metal contamination**

A. Bertucci, F. Pierrou, University of Bordeaux / UMR EPOC CNRS 5805; J. Thébault, Université de Bretagne / LEMAR UMR 6539 CNRS/UBO/IRD/Iffrem; C. Klop, INRA Institut National de la Recherche Agronomique / Plate-forme bio-informatique Genotoul, Mathématiques et Informatique Appliquées de Toulouse; J. Bellec, Université de Bretagne / LEMAR UMR 6539 CNRS/UBO/IRD/Iffrem; F. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; M. Baudrimont, Université de Bordeaux / UMR EPOC CNRS 5805 The freshwater pearl mussel Margaritifera margaritifera is one of the most threatened freshwater bifales worldwide. In this study, we aimed to (i) study the processes by which water quality might affect freshwater mussels in situ and (ii) provide insights into the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies. Margaritifera margaritifera specimens were sampled in two close sites located upstream or downstream from an illegal dumping site. The renal transcriptome of these animals was assembled and gene transcription determined by RNA-Seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochronology) and condition index were determined in order to identify genes likely to respond to a specific factor. Amongst the studied metals, Zn, Cu, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimuli and transport pathways. However, the main factor explaining changes in gene transcription appeared to be the age of individuals with a negative correlation with the transcription of retrotransposons-related genes. To investigate this effect, animals were classified into 3 age classes. In young, middle-aged and old animals, transcription levels were mainly explained by Cu, Zn and age, respectively. This suggests differences in the molecular responses of this species to metals during its lifetime that must be better assessed in future ecotoxicology studies.

411  
**L-CHRMS-based metabolomics to highlight biotransformation products and effects of dicyfenac in Mytilus galloprovincialis**

F. Courant, Université de Montpellier - UMR 5969 Hydrosciences / UMR Hydrosciences; B. Bonnemille, H. Fenet, Université de Montpellier / UMR Hydrosciences; E. Gomez, Université de Montpellier, Hydrosciences Montpellier UMR 5969 / UMR Hydrosciences; M. Margaritifera to trace metal contamination

Dicyfenac (DCF) has become a major contaminant of interest as shown by its inclusion in the EU Water Framework Directive (2000/60/EC). However, relatively little is known regarding its biotransformation and effects in the Mediterranean mussel. Environmental metabolomics affords several advantages to study both topics. The metabolome refers essentially to i) the endometabolome, constituted by endogenous metabolites, and to ii) the xenometabolome, in reference to xenobiotics and their biotransformation products [1]. Metabolomics profiles acquired through mass spectrometric techniques may reveal the exposure by direct detection of xenobiotics and their metabolites (xenometabolome investigation) and effects by the detection of endogenous metabolites which concentrations may differ from physiological levels following the exposure. Investigation of the metabolome involves in many cases long-term experiments, an experiment was carried out whereby marine mussels were exposed for 7 days to ethanol (< 1°/oo, vehicle) or to 100 µg/L DCF. Analytical methods relying on Liquid Chromatography-High Resolution Mass Spectrometry were developed to generate metabolic profiles from mussel’s tissues. The obtained profiles for both groups (controls and exposed) were compared. We highlighted DCF and 13 DCF metabolites in exposed mussels. Three of them were phase I metabolites such as...
4'-hydroxy-diclofenac, and 10 were phase II metabolites such as amino acids conjugates. Five were reported for the first time in an aquatic organism. Regarding the effects, two main metabolic pathways were found to be impacted by diclofenac exposure. The tyrosine metabolism was mostly down-modulated and the tryptophan metabolism was mostly up-modulated. To our knowledge, such DCF effects on mussels have never been described despite being of concern for these organisms. Atyehalamines and serotonin are involved in osmoregulation, and in general release in mollusks [2-4]. Our results highlighted potential impairment of mussel osmoregulation and reproduction following a DCF exposure in agreement with recent publications that have shown reproductive disturbance following DCF exposure in other aquatic organisms such as xenopus [5] or fish [6].


Pong et al., Exp. Zool. 267, 475 (1993) \cite{Pong1993} \quad \text{Fong et al., Exp. Zool. 266, 79 (1993) \cite{Fong1993}}

Efsosa et al., Chemosphere 173, 69 (2017) \cite{Efsosa2017} \quad \text{Gröner et al., Chemosphere 166, 473 (2017)}

412 Metabolomics used to link affected molecular pathways with behaviour outcomes after a single dose of pesticide exposure in polar bears

P. Leorants, VU University, Institute for Environmental Studies / Department of Environment and Health; H. Viberg, I. Lee, S. Buratovic, P. Eriksson, Upsala University

Worldwide, serious concern has arisen about the increased incidence of learning and developmental disorders in children. From a scientific point of view, there is no doubt that exposure to neurotoxic chemicals during early brain development can adversely affect learning and development. Various recent epidemiological studies have indicated that exposure to low doses of environmentally active contaminants (e.g. pesticides) during human development can have deleterious effects on cognitive development in childhood. The European commission-funded project DENAMIC "Developmental Neurotoxicity Assessment of Mixtures in CHildren" investigates neurotoxic effects (e.g. learning and developmental disorders) of low-concentration mixtures of pesticides and a number of common environmental pollutants in children. We focus on (subclinical) effects on learning (cognitive skills) and developmental disorders in children (e.g. ADHD, autism spectrum disorders and anxiety disorders). The aims are to develop better and sophisticated tools, procedures and testing methods to screen compounds for (developmental) neurotoxicity, and to improve our understanding of chemical exposures and the observed effects (www.denamic-project.eu). As part of the project, a new alternative assessment strategy based on a combination of \textit{in vitro}, \textit{in vivo} assays, omics, and human exposure assessment is under development in order to prioritize compounds, and to further investigate the pathways and mechanism involved in disorders and diseases. The final aim of DENAMIC is to reduce effects of environmental contamination on learning and developmental disorders in children. In the current study metabolomic pathway analysis was used to improve our understanding of the underlying molecular mechanisms of observed effects on behaviour and cognitive function after various pesticide and other contaminant exposures in mice.

413 Relationships Between Persistent Pollutant and Metabolomics Profiles in Tissues of Polar Bears From Hudson Bay, Canada

A.D. Morris, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division; M. Dyck, Government Of Nunavut / Nunavut Department of the Environment; B. Chandramouli, J. Cosgrove, SGS Ecotoxicology and Wildlife Health Division; M. Dyck, Government Of Nunavut / Department Of Ecological Sciences; A. van Straalen, Association of Registered Environmental Scientists ARES / Department of Ecotoxicology; A. Betz, Eawag / UTOX

At present, environmental risk assessment of chemicals is limited to measuring physiologically endpoints in model species. To test all chemicals that require testing, a shift to mechanistic-based testing is needed. However neither direct molecular targets nor the stress pathways that lead to adaptation to chemical exposure are usually known. Finding the genes encoding sensitivity or tolerance to chemicals is one of the highest priorities of the (eco)toxicological research community. One of the best methods for gene function discovery is functional genomics based on functional genomics. There are several methods of testing the effects of chemical interventions (such as chemical exposure) of interest and mutants which are the most susceptible to the intervention and those that are most tolerant are found. We exposed a ploidy library of loss-of-function mutants of \textit{Chlamydomonas reinhardtii} to three herbicides that target photosynthesis: atrazine and diuron which target photosystem II, and which reaches the disruption of electrons from photosystem I to photosystem II, and which leads to production of reactive oxygen species. The pooled library was exposed to the EC20 concentration of each herbicide for 3-4 days, at which time samples from the library were taken for DNA sequencing to find mutants that have become enriched or have disappeared from the culture after exposure (compared with non-exposed control). The expectation was that the functional genomic profiles of atrazine and diuron would be similar, as the target of both chemicals is the same, while a different profile would be obtained for paraquat. This was indeed the case, with the profiles for both diuron and atrazine enriched for mutant of genes involved in the photosynthesis. The profiles of paraquat also included photosynthetic genes, but also several genes involved in defence against oxidative stress. These results have been published in recent publications that have shown reproductive disturbance following DCF exposure in other aquatic organisms such as xenopus [5] or fish [6].
stress and lipid metabolism. Finally, there were also several genes that were among the enriched separately for diuron and atrazine, which points to possible different secondary modes of action for both herbicides. While we are currently still analyzing the obtained profiles and individual genes, our results demonstrate that functional genomics is a useful method for discovery of molecular mechanisms of chemical toxicity.

**Harmful effects of plastic litter and mitigation strategies in the Mediterranean Sea**

416 **Harmful effects of plastic litter on Mediterranean Biodiversity: what and what’s new?**
M. Fossi, M. Baini, C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment

Concern about the occurrence, quantity and effects of marine litter in the world’s ocean and seas has grown rapidly in recent years, attracting interest from a wide range of stakeholders. Environmental NGO, the scientific community, the media and the general public. Mediterranean Sea, which is a crucial biodiversity hotspot and a critically polluted area, has been also described as one of the areas most affected by marine litter, including microplastics, in the world. Recent studies in the different regions of the basin suggested that some areas are affected by important concentration of microplastics and plastic additives, representing a potential risk for endangered species (baleen whales, sea turtles, filter feeders sharks) and for the all Mediterranean biodiversity. To cover the current knowledge gaps on this issue a harmonised methodological approach for the assessment of the marine debris impact on Mediterranean biodiversity is needed. The quantification of marine debris/microplastics in the marine environment can depend on several environmental factors and change according to multiple oceanographic features, and therefore, cannot reflect the potential impact on organisms and ecosystems. The information obtained by biondicator species could better integrate the spatial and temporal presence of marine litter/microplastics in the marine environment. In addition, the use of biondicators can allow to measure not only the occurrence of marine litter in the species and its environment but also the threat posed to organisms by the evaluation of contaminants accumulation and any existing biological effect. A new integrated monitoring tool that would provide the information necessary to design and implement future mitigation actions in the Mediterranean basin is proposed. Applying ecological and biological criteria to the most threatened species observed by statistical analysis, biondicator species for different habitats and monitoring scale were selected. To assess the harm by marine debris ingestion a threefold approach, simultaneously measuring the presence and effects (accumulation of plastic associated contaminants and biomarker responses), can provide the harm and the sub-lethal effects to organisms related marine litter ingestion. The gaps pointed out by this research and the biondicators species selected could represent a step forward for the risk assessment and the implementation of future mitigation measure for the Mediterranean area, habitat and species affected by marine litter ingestion.

417 **Impact of marine litter in the Mediterranean Sea: monitoring and specific reduction measures within MSFD**
F. Giliani, IFREMER

Possible assessments of the state of the marine environment, monitoring and the formulation of environmental targets are perceived as part of the continuous management process within the MSFD. Of the 11 descriptors listed in Annex I of the MSFD for determining GES, Descriptor 10 has been defined as “Properties and quantities of marine litter do not cause harm to the coastal and marine environment”. In 2016, the Revised Commission Decision identified four indicators for Descriptor 10, of which two are focusing on harm considering (i) The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned (indicator 10DC3), and (ii) The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects (indicator 10DC4). For these two indicators, Member States shall establish that list of species affected. The thresholds and values for these levels through regional or sub-regional cooperation. In the context of the Mediterranean Sea, we discuss the ongoing work that is focusing on the implementation of monitoring and reduction measures, defining constraints, protocols, better defining harm and research needs to support monitoring efforts and reduction measures. The analysis of existing data will reveal (i) the suitability of some approaches for better monitoring the adverse effects of litter, and (ii) the potential of visual observations of the sea floor for the measurement of interactions between litter and invertebrates as an approach for evaluating entanglement. Strategies for the implementation of monitoring are discussed, as well as risk assessment and the possible associated measures within MSFD.

418 **Addressing the growing threat of marine litter: NGOs essential role in strengthening the science-policy-society interface**
T. Vlachogianni, Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE)

The growing urgency and complexity of interconnected societal challenges, such as marine litter, demand that they be addressed through the strengthening of the science-policy-society interface so as to provide the necessary conditions for translating research-based knowledge into effective action. NGOs are essential partners in promoting environmental protection and sustainable development. Their active participation at local, national and transboundary level in all phases of projects and processes, from their design, implementation in the field, operationalization, monitoring and evaluation, contributes not only to increased transparency, wide visibility and outreach of the project or process, but also to enhanced overall quality and increased ownership of the outcomes, as well as amplified possibilities for replication of its activities. In full acknowledgement of the prominent role of NGOs in the realm of environmental governance, MIO-ECSDE, a Federation of some 130 Mediterranean NGOs working on Environment and Sustainable Development, in fulfilling its vision and mission, has developed and implemented a number of actions on the science-policy-society interface that address the growing threat of marine litter in the Mediterranean, ranging from the monitoring and influencing of relevant policy, all the way to hands on and pilot activities (e.g. within the framework of the IPA-Adriatic DeFishGear, the FP7 MARLISCO, the Intereg Med ACT4LITTER, the EU SWIM-H2020 SM, etc.). How marine litter and its inherent environmental, economic, social, political and cultural dimensions have been tackled by MIO-ECSDE illustrates the broad extent of involvement and interventions required for the protection of the marine and coastal. The term “biodegradable” could be misunderstood and induce false positive and particular strengths that the NGO community brings to environmental governance, such as leadership, creativity, flexibility, entrepreneurship and capacity for vision and long-term thinking. As scientists call for more research on global environmental changes in an effort to gain a better understanding of the human induced implications for all of life on Earth, it remains an inconvenient truth that if the world had acted upon the knowledge that the scientific community already produced, the state of many ecosystems would be different today. The NGO community has an essential role to play in terms of strengthening the science-policy-society interface towards an effective response from society on the issue of marine litter and other societal challenges.

419 **Biodegradable plastics: potential application in aquaculture and other applications at high risk of dispersion**
F. De Filippi Innocenti, Novamont SpA

The problem of plastic marine debris is caused by inadequate waste management and improper investment in prevention, and recovery programs. The bioplastics industry does not consider biodegradability as a license for littering in the environment. All packaging and consumer products must be recovered in some way at their end of use and, in certain contexts, biodegradability allows recovery through organic recycling. This option is contemplated by the European Directive on Packaging and it is beneficial whenever packaging is mixed with food waste (biodegradables). The term “biodegradable” could be misunderstood and induce false positive and particular strengths that the NGO community brings to environmental governance, such as leadership, creativity, flexibility, entrepreneurship and capacity for vision and long-term thinking. As scientists call for more research on global environmental changes in an effort to gain a better understanding of the human induced implications for all of life on Earth, it remains an inconvenient truth that if the world had acted upon the knowledge that the scientific community already produced, the state of many ecosystems would be different today. The NGO community has an essential role to play in terms of strengthening the science-policy-society interface towards an effective response from society on the issue of marine litter and other societal challenges.
Management (RPML) in December 2013, providing for a set of programmes of measures and implementation timetables to prevent and reduce the adverse effects of marine litter on the marine and coastal environment. It includes innovative and traditional measures of a policy, regulatory and technical nature, addressing different aspects of marine litter prevention and management from land and sea based sources. The Regional Plan measures impose clear obligations regarding the waste management hierarchy, closure of illegal dumping/dumpsites, shift to sustainable consumption and production patterns, removal of existing marine litter using environmental sound practices e.g. fishing for litter, clean up campaigns, port reception facilities at possibly no special fees, and monitoring, assessment and reporting on implementation of measures as well as enforcement of national legislation. Significant effort has been made on marine litter at regional and national levels, since the adoption of the RPML. The Mediterranean countries have included marine litter in their updated National Action Plans (NAPs) and the ambitious and novel Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria has been adopted since 2016 by the Mediterranean countries including two common and one candidate indicators on marine litter. Furthermore, with the support of the EU-funded Marine Litter MED project, UN Environment/IMAP is implementing key reduction and prevention measures on marine litter in the Southern Mediterranean. At the invitation of the UN Environment/MAP, the Regional Cooperation Platform on Marine Litter in the Mediterranean was established in September 2016, consisting of more than 20 international and regional partners with a clear mandate on marine litter management. The aim of the platform is to assist to the cooperation with the RPML, a further step has been resulted, towards a more effective marine litter management at regional level. One of the latest developments of the UN Environment/MAP is the 2017 Mediterranean Quality Status Report (QSR) that dedicates two chapters on marine litter related to beach, floating, and seafloor marine litter.

421 Science and awareness: a Mediterranean Connection Against Marine Litter. First Results of the Commitment Presented at UN Ocean Conference

G. Zampetti, Legambiente

"Science and awareness: a Mediterranean connection against marine litter" is the title of the voluntary commitment that Legambiente and the University of Siena presented at the last UN Ocean Conference in New York, in June 2017. There was a connection between scientific research and raising awareness built to tackle marine litter in the Mediterranean Sea by sharing experiences and developing a new integrated action. In 2013, Legambiente started the monitoring of floating macro litter within Goletta Verde, one of the most popular campaigns of analysis and information about sea pollution. In the last few years, there has been an increase in the marine-litter-related activities, including surveys using citizen science and awareness raising projects. Following the Scientific Environmentalism purpose Legambiente applied official methods and protocols to contribute to the estimation of the marine litter amount in seas and along the coastline, cooperating also with national research institutes, universities and other research organizations. Now, thanks to the cooperation with the University of Siena, a further step has been resulted, carried out studies and research on the presence of contaminants adsorbed by floating plastics and their potential effects on biodiversity. The first results of this research will be presented in this meeting.

422 Discussion

423 Final Remarks

G. Leone, UNEP/Mediterranean Action Plan

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (II)

424 Biodiversity patterns in the GLOBAQUA basins and their relationships with multiple stressors

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Rivers suffer from an important decrease in species diversity compared to other aquatic and terrestrial ecosystems due to a variety of stressors related to human activities. Species play different roles in the functioning of the ecosystem, and their specialization may reduce the response capacity of the ecosystems to a stressor. The effects on diversity will obviously differ based on the type of stressors and their combination and severity, as well as on the characteristics of the local community composition, and the community tolerance to the type of stressor affecting the system. This study presents the results of the analyses of the biodiversity patterns for benthos, algae, macrophytes, macroinvertebrate and fish communities related to environmental pressures. The data obtained from the field work conducted in three of the Globauca case study basins (Adige, Sava and Evrotas) has been evaluated according to structural biological community parameters (species composition and abundance). The most evident relationships between changes in species richness and diversity were explained by changes in hydrology (e.g. mean discharge, intermittency) and morphological changes in the basins (e.g. land uses, channel transformation). The presence of pharmaceutical products (urban pollution) and pesticides was related to lower insect richness. Also emerging compounds, despite their low concentrations, were related with a reduction in macrophyte diversity. These results open the way to compare responses in the studied basins as representative of the European reality of the combined effects of multiple stressors on biological diversity.

425 Changes in pH after the reproductive toxicity of common active pharmaceutical ingredients

C.-M. Hjät, N. Wichman, C. Lewis, K. Smith, A. Wilson McNeal, University of Exeter / Department of Biosciences; J. Snape, AstraZeneca UK Ltd. / AstraZeneca

Global Environment; T.S. Galloway, University of Exeter / Biosciences Increasing pH in aquatic environments is occurring as a consequence of the release of anthropogenic carbon dioxide in the atmosphere, which is absorbed by surface waters. Traditionally this stressor has been studied in isolation, however environmental variation such as changes in pCO2 or pH can alter the ionisation and consequently the effects of contaminant compounds. A notable group of compounds susceptible to these changes include the active pharmaceutical ingredients (APIs), which often have pH-specific biological effects and are increasingly detected during sewage effluent and receiving waters. The aim of this study is to investigate the hypothesis that changes in pCO2 alter the effects of active pharmaceutical ingredients on sperm swimming parameters and fertilisation success. The species chosen to explore these effects were the lugworm Arenicola marina and the purple sea urchin Paracentrotus lividus due to their being keystone coastal species in areas where API contamination is occurring, and them being established model species for artificial spawning in controlled laboratory conditions. We used a range of neonicotinoid pesticides and non-steroidal anti-inflammatory drugs (NSAIDs) at both environmentally relevant and mechanistic concentrations to test this relationship due to them having chemical properties identified as making them pCO2-sensitive. pCO2 conditions equating to current (8.10 ± 0.1) and future (7.75 ± 0.1) pH conditions were selected for this study. Endpoints measured included a range of sperm motility parameters, using computer-assisted sperm analysis (CASA) software and fertilisation success. Our findings indicate that pCO2 conditions may play a vital role in altering the reproductive toxicity of common chemical pollutants through changes in sperm swimming parameters and consequently fertilisation success. Our results also indicate that this combination of stressors is compound-specific between contaminants with multidirectional effects dependent on conditions of the exposure. Our findings provide novel evidence that future environmental conditions may substantially alter the role which contaminants such as APIs play in the environment. API contamination is likely to increase following anthropogenic pressures such as population growth and healthcare advances. As a result, we believe it necessary to consider future conditions such as increased pH conditions when accurately assessing the environmental risks of such compounds.

426 From individual traits to ecosystem functioning: natural phytoplankton community responses under combined environmental stress and chemical pollution

D. Bahlo, Norwegian Institute for water research; E. Leu, Akvaplaninna AS; F. Pothecary, Eawag Swiss Federal Institute of Aquatic Science and Technology; J. Buchholtz, Eawag Swiss Ecology; J. Eoe, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; D.O. Hessen, University of Oslo / Department of Biosciences; J. Norberg, Stockholm Resilience Centre; L. Nizzetto, NIVA

Phytoplankton are crucial for lentic ecosystems productivity and foodwebs, but facing multiple antrhopic challenges that may lead to complex alterations of their ecology and function. Climate change is expected to decrease the stability of lentic ecosystems and enhance fluctuations in environmental conditions. More frequently occurring storm events will potentially disrupt the normal stratification patterns in boreal lakes, thereby dispersing algae from the depth layers they are optimally
acclimated to. Many species of algae are highly adaptive and can respond by growing rapidly after disturbance. However, the diffuse burden of chemical pollutants concomitantly present in freshwater ecosystems, can favour species of algae that are more tolerant to chemical pollution to the detriment of more adaptive species of algae that are more tolerant to chemical pollution to the detriment of more adaptive species. Algae, which are able to grow rapidly after disturbance, can prevent the ecosystem to promptly re-gain structures and functions after extreme events. An extreme meteorological event was mimicked by sampling and mixing phytoplankton communities over the entire water depth of the lake. The chemical stressors comprised of a mixture of chemical pollutants added to the mesocosms at five increasing concentrations (typically considerably below the EC₅₀ of individual pollutants). The mixture included 12 pharmaceuticals and personal care products commonly detected in lakes and rivers in Europe. In addition, a mixture isolated from treated waste water effluents was used as a treatment of its own. Individual level traits (cell size, pigments), community parameters (biodiversity, functional diversity, species composition and photosynthetic efficiency), chemical concentrations and nutrients were routinely monitored during the 33 days experiment. Of particular importance, contaminant stressors and environmental factors have a drastic persistent impact on the different levels of organisation of the phytoplankton community. At community level, contaminant decreased the photosynthetic yield. At higher concentration levels these effects persisted throughout the duration of the experiment, resulting in lower productivity and communities with contrasting. This suggests that diffuse chemical stressors can disrupt the capacity of natural communities to handle environmental changes.

427 The role of multiple stressors in an Alpine river and the response of the macroinvertebrate community

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In this study the combined effects of hydrological and chemical stressors on benthic macroinvertebrates are evaluated in order to explore the response of the biological community in relation multiple pressure factors. The Adige River, located in the Southeastern Alps, was selected as a case study because representative of a variety of catchment characteristics. The Adige River is characterised by high urbanisation and industrial activity. This study relies in giving a comprehensive and general explanation of the response of biological communities to multiple stressors investigated in an Alpine environment; in particular the analyses performed allow to distinguish the main pressures that impact macroinvertebrates in the Adige river.

428 Coping with antidepressants in a changing ocean: tissue bioaccumulation and behavioural implications in juvenile Argyrodes roesigii exposed to venlafaxine


Anthropic activities have contributed to great environmental challenges: remarkable chemical contamination and dramatic climate change. Both factors strongly affect marine ecosystems and are expected to worsen in the future, threatening marine species’ welfare and survival. Yet, information on how fish will cope with the presence of chemical contaminants in the future is still extremely limited. Emerging and non-regulated pharmaceutical and personal care products (PPCPs) have recently become a great environmental concern, since these compounds are often discharged into the aquatic environments, but their elimination through conventional wastewater treatments is rather limited. Within pharmaceuticals of human use, venlafaxine (VFX) is one of the most ubiquitous in the aquatic environment, often reaching higher concentrations than other well-known psycho-active drugs, such as fluoxetine (i.e. Prozac). In this context, the present study was conducted with the first time to evaluate effects of seawater warming and acidification on VFX bioaccumulation in fish tissues, as well as the behavioural implications resulting from the exposure to these stressors (alone or combined), using juvenile meagre (Argyrosomus regius) as model organism. Overall, data evidenced that seawater temperature and pCO₂ levels can strongly affect the bioaccumulation patterns of antidepressants in marine organisms. Furthermore, the distinct behavioural patterns observed when VFX contamination, acidification and warming acted alone or in combination evidenced that multiple environmental stressors should be considered when assessing fish behaviour under a future changing ocean. The results here gathered further strengthen the need to carry out greater research efforts to understand how multiple environmental stressors interact with each other.

429 A modelling approach to assess present and future land use pressures on a salmonid river: a case study in the River Tamar catchment (UK)

M. Assuncao, Celas Lowestoft Laboratory; P. E. Posen, Centre for Environment Fisheries and Aquaculture Science Cefas; M. Nendza, Centre for Ecology and Hydrology

A linked-model approach was applied to the River Tamar catchment (Southwest, UK) to assess current and likely future impacts of land use practices on salmonid populations; Atlantic salmon (Salmo salar) and brown trout (Salmo trutta). Land use data were incorporated into a validated water quality model (QUEST) at the sub-catchment scale and a baseline generated for the period for 2000 to 2012. Future scenarios of water quality were also generated based on land use practices recommended under ongoing catchment initiatives. Overall, the baseline water quality parameters found to be non-compliant with “Good Status” under the Water Framework Directive, or outside the freshwater requirements for salmonids, were found to be associated with reported land use pressures in the Tamar, namely, catchment-wide frequent elevated levels of inorganic phosphorus and, less frequently, suspended sediments. Tested future land use scenarios bringing improvements in inorganic phosphorus levels included upgrading technology at sewage treatment plants and the implementation of riparian buffer strips, combined with a corresponding reduction in livestock density. These improvements however, were marginal therefore the tested land use scenarios should be adjusted and/or new scenarios explored. Baseline seasonal average values for water quality parameters in different areas of the catchment explained 68% of salmon and trout fry density variation, and showed how different parameters might be affecting the density of these two species. Our results suggest that catchment pressures are contributing to the regulation of salmonid fry densities in some tributaries and upper catchment reaches. Moreover, they can be used to inform local and seasonal targeted measures, aimed at improving those water parameters most influential on fry densities. These types of measures are likely to bring the highest benefits to salmonid productivity in the catchment.

430 Evaluation of PBt and PVb substances based on exposure dynamics, use-specific impacts and costs for emission reduction or abatement in the context of REACH

S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Nendza, Analytisches Laboratorium A key objective of the European chemicals legislation REACH is to ensure that the risks caused by substances of very high concern (SVHC) are adequately controlled. The two regulatory procedures adopted in REACH to control the risks arising from SVHCs are authorisation and restriction. Both regulatory instruments make use of socio-economic analysis (SEA), which is generally defined to be a tool for assessing all relevant positive and negative impacts from substances use non-use, and for comparing these impacts across different scenarios. Impacts arising from chemicals use, import, export of PBt/PVb substances are use-specific. Furthermore, due to stock polltion properties of PBt/PVb, impacts may last for long periods and even long after emissions have ceased. In addition, information about (long-term) impacts needs to be balanced with costs of emission reduction and abatement. Acknowledging that monetary valuation of impacts using stated or revealed preference methods is not possible for a broader set of PBt/PVb substances, the evaluation of PBt/PVb substances in a SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e.
target values (standards) by means of which it can be determined whether or not the costs of a control measure are excessive. This paper suggests an approach for the evaluation of PBT/vPvB substances by means of CEA that accounts for the complex environmental distribution patterns, and that allows balancing (long-term) impacts from PBT/vPvB use against costs for emission reduction and abatement. The approach proceeds along a sequence of steps and uses different analytic tools and data. Starting with a grouping and ranking of PBT/vPvB substances, exposure dynamics are analysed with a multimedia partitioning approach. Based on the assessment of exposure dynamics in different compartments, impacts arising from the stock can be evaluated via different routes. To assess the cost-effectiveness and proportionality of possible (policy-) measures for PBT/vPvB control, the routes to impact evaluation are linked to assessments of costs for restricting or stopping a specific use or multiple uses of a PBT/vPvB substance and to benchmarks being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared. As illustrative case study, the approach is applied to perfluorooctane sulfonate (PFOS).

431 Grouping and relative ranking of the impact potential of PBT/vPvB substances for comparative assessments in the context of socio-economic analysis under REACH
M. Nendza, Analytisches Laboratorium; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies / Limburgs Universitair Centrum; S. Disse, RWTH Aachen University The assessment of PBT/vPvB substances under REACH may evaluate long-term exposure dynamics and impact potential. Grouping and relative ranking of PBT/vPvB substances can support comparative assessments of either several substances with the same use, or for a particular substance with different uses (emission patterns) in the context of socio-economic analysis (SEA). The aim of the grouping is to identify substances that are characterized by a certain similarity of properties/behaviour with chemicals with known impacts, serving as points of reference for the impact evaluation. The relative ranking of PBT/vPvB substances is based on an impact score, which captures diverse properties and effects of target substances. The impact score consists of individual scores assigned to expected environmental stocks, possible effects of PBT/vPvBs on the environment and on human health via the environment (toxicological benchmarks), and to other specific concerns. The resulting fingerprints of concern (pattern of the individual scores) and the overall scores for impact potential can be used for comparative assessments. For example, if similar fingerprints are observed for two substances with a similar use, the total score gives an indication which substance might be less (or more) critical. For 17 case study chemicals, data on partitioning properties (log Kow, log Koa), stocks in water/sediment and soil, long range transport potential (LRTP), overall persistence (Pov), toxicological benchmark values for water and soil, CMR properties (H-phrase), endocrine disruption (ED) potential, production/emission volume, and use pattern have been collected from REACH dossiers or estimated with suitable tools. The examples illustrate the possibility to lump all information for a specific or multiple uses of a PBT/vPvB substance, and to benchmarks, being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared. As illustrative case study, the approach is applied to perfluorooctane sulfonate (PFOS).

432 Interpretation of non-extractable residues (NERs) in the persistence assessment

SETAC Europe 28th Annual Meeting Abstract Book
There is already a long discussion around the bioavailability and ecotoxicological relevance of Non Extractable Residues (NER) in soil. Is NER formation a definitive indication that it should be considered to be a hidden hazard? NER can only be established using labelled chemicals (e.g. 14C) and cannot be measured with conventional chemical analytics. But even using labelled compounds uncertainty exists about the identity of measured radioactivity. Do we measure: 1) Strong adsorption or association of the parent chemical or breakdown product with mineral and/or organic matter, 2) Mineralisation and incorporation of carbon into microbial biomass; the latter two parameters ask for unmeasurable and measurable fraction. The approach of Ortega-Calvo et al. (2015) has been followed, because this approach defines clear and measurable fractions. The only non measurable fraction is NER, but can be considered as a residual fraction if all others are measured. Considered are: Chemical present in the water phase, actual available, (Passive sampling or CaCl₂-extraction) A potentially available fraction in equilibrium with a potentially mobile fraction (Texas IRS - TS-16751); The total extractable amount, measured with a (standard) method NER is considered, but mentioned as non-measurable and also non-bioavailable. We studied three NER-forming chemicals and followed their fate in a period of 6 months after addition. An important part of the study were experiments using 13C chemicals. In first experiments formation of Non-Extractable 14C was observed for all chemicals. For the chemical Tr-NitroToluene (TNT), NER-formation was reproducible and NER formation during aging removed toxicity. By removing the bioavailable fractions directly after spiking and after aging it was also possible to remove toxicity. The experiments with and also without labelled NER clearly showed that toxicity was caused by the bioavailable chemical and not by NER. The tool developed can be used if the fate of the chemical including NER formation is obvious. With the other selected chemicals Cypermethrin and Carbendazim, results were less clear, because there was a large uncertainty in NER-formation. The degree of biodegradation was not reproducible for Cypermethrin and unexpected losses occurred with Carbendazim. This gave a very large uncertainty about NER using non-labelled compounds. For these compounds it is not possible to draw conclusions from only a non-labelled experiments.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (I)

436 How to make LCA fit for purpose as decision making tool E. Mieras, PRe Sustainability; A. Gaasbeek, PRe Consultants / Consultancy; J. Courtiolias, PRe Consultants

To understand how Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) can be improved to support decision making we first have to look at how decisions are made. One of the first distinctions that are made when it comes to decision making is between normative and descriptive decision making. The latter describes how people actually make decisions and that can be difficult to make the right decision when it comes to environmental and social impacts. Until now, decision makers have not been trained how to make decisions. The importance of sustainability in transportation infrastructure has raised in recent years in response to the link between anthropogenic activity and global challenges, such as climate change, as well as in consequence of the ongoing development of models quantifying the social and economic impacts resulting from infrastructure development. Therefore, addressing the sustainability of transportation infrastructure requires exploring the environmental, social, and economic impacts of technological options while balancing the often-conflicting priorities of different stakeholders. At an early design phase of the infrastructure delivery process. That is a typical multi-criteria decision-making (MCDM) problem, in which the decision-makers need to measure the sustainability through a set of meaningful, representative and quantifiable criteria, balance the relative importance of those criteria and determine the sustainability sequence of multiple alternative technologies for fostering transportation sustainability. In order to help the decision-makers to efficiently perform this challenging task, a decision support tool (DST) was developed in the scope of the training-through-research programme Sustainable Pavements & Railways Initial Training Network (www.superitn.eu). It consists of a computational platform that implements a conceptual framework developed to quantify sustainability. It comes with a set of sustainability indicators tailored to both road and railway systems as well as several objective and subjective weighting methods. Amongst those belonging to the last category, the DST includes a set of default weights derived from an Analytical Hierarchy Process (AHP)-based survey that engaged stakeholders from different sectors and from several European countries. At last, the Preference Ranking Organization Methodology of Enrichment Evaluation II (PROMETHEE-II) MCDM method is employed for prioritizing candidate pavements and railway tracks at the design stage. The DST will be freely available and can be used at professional level, by professionals interested in advancing sustainability in transportation, as well as for educational purposes, to provide knowledge and educate on the use sustainability concepts and on what are the important issues to consider during the sustainable transportation decision-making process.

437 Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Development in the Biopharmaceutical Industry

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6-Aminopenicillanic acid (6-APA) is the beta-lactam nucleus of penicillin and is the intermediate to most semisynthetic antibiotics. Manufacturing of the nucleus represents one of the largest production scale processes within the biopharmaceutical industry. Although the importance and the contributions to the industry are poorly understood, due to limited life cycle assessment (LCA) studies in the literature, the paper presents a LCA of 6-APA production to illustrate the burdens manufacture places on the environment as a function of manufacturing location. We make recommendations for future development of large scale biopharmaceutical manufacture by drawing on our 6-APA analysis where necessary. The main focus is between what type of decisions are made, by whom and what the objectives are. Thus, overuse of local freshwater may compete with other sectors, e.g. agriculture, accessing this resource. This suggests that location of production is a critical factor in the planning of biopharmaceutical manufacturing.

438 A SUSTAINABILITY PERFORMANCE-BASED METHODOLOGY AND TOOL FOR ECODESIGN: the case of transport infrastructures D. Le Pera, The University of Nottingham / Nottingham Transport Research Centre / Nottingham Environmental Engineering Centre NTEC; J. Oliveira Do Santos, IFSTTAR; S. Bressi, University of Palermo; S. Brodie, The University of Nottingham; J. Bryce, AMEC Foster Wheeler; V. Cerezo, IFSTTAR; T. Parry, The University of Nottingham; G. Di Mino, The University of Palermo

The importance of sustainability in transportation infrastructure has raised in recent years in response to the link between anthropogenic activity and global challenges, such as climate change, as well as in consequence of the ongoing development of models quantifying the social and economic impacts resulting from infrastructure development. Therefore, addressing the sustainability of transportation infrastructures requires exploring the environmental, social, and economic impacts of technological options while balancing the often-conflicting priorities of different stakeholders. At an early design phase of the infrastructure delivery process. That is a typical multi-criteria decision-making (MCDM) problem, in which the decision-makers need to measure the sustainability through a set of meaningful, representative and quantifiable criteria, balance the relative importance of those criteria and determine the sustainability sequence of multiple alternative technologies for fostering transportation sustainability. In order to help the decision-makers to efficiently perform this challenging task, a decision support tool (DST) was developed in the scope of the training-through-research programme Sustainable Pavements & Railways Initial Training Network (www.superitn.eu). It consists of a computational platform that implements a conceptual framework developed to quantify sustainability. It comes with a set of sustainability indicators tailored to both road and railway systems as well as several objective and subjective weighting methods. Amongst those belonging to the last category, the DST includes a set of default weights derived from an Analytical Hierarchy Process (AHP)-based survey that engaged stakeholders from different sectors and from several European countries. At last, the Preference Ranking Organization Methodology of Enrichment Evaluation II (PROMETHEE-II) MCDM method is employed for prioritizing candidate pavements and railway tracks at the design stage. The DST will be freely available and can be used at professional level, by professionals interested in advancing sustainability in transportation, as well as for educational purposes, to provide knowledge and educate on the use sustainability concepts and on what are the important issues to consider during the sustainable transportation decision-making process.
Environmental risk assessment and management of the material produced in tunnelling excavation

442 Characterization and management of excavated soil and rock
G. Mininni, CNRIRSA; A. Sciotti, F. Martelli, Italfer SpA
This paper describes some case studies relevant to management of excavated soil and rock (ESR) produced when tunnelling is performed using Tunnel Boring Machine with Earth Pressure Balance system (EPBs-TBM). ESR can be alternatively qualified as waste or as by-products depending on utilization conditions (in particular, certainly of further use) and on their characteristics (especially in terms of environmental and health protection requirements). Tunnels construction entails production of large quantities of ESR, up to several millions of tons. Their management as a waste certainly requires a huge amount of financial means and time, which also has a significant impact on the overall project cost. Moreover, the operation of a tunnel affects the environment, the society, the economy and the environment. The management of ESR includes information on management model of ESR, adopted treatments before final use (considered as normal industrial practice) and final destination. Different approaches clearly appear from this study: in the Northern part of Italy authorities have allowed to use the ESR as by-products while in the area of Rome management as waste prevals. Other cases such as Crossrail (the railway tunnel crossing London), Cityringen, (Copenhagen underground) and Le Grand Paris (Paris metro) will be discussed. The new circular economy package of the European Commission will push all the member states to move from linear to circular economy with consequent reduction of natural resource exploitation. ESR can be one of the important sector where the challenging objectives may be reached. Now in Europe does not exist a clear understanding of the legislative measures and technical rules needed to harmonize the ESR management. Protocols are needed for their characterization, including borderlines, limit values of some contaminants should be fixed to consider ESR as by-products, the allowed treatments as normal industrial practice should be clearly stated. Current legislation may have a non-unique interpretation and therefore the operators are exposed to uncertainties. The general principles of fair competition inside Europe are totally disregarded.
The use of foaming agents and additives is one of the fundamental factors allowing the correct use of the EPB-TBM (Earth Pressure Balanced Trench Boring Machine) for the excavation of underground works. On the other hand, their use must be carefully assessed in environmental terms, starting from the initial planning stages, in order to meet the requirements for the excavation site. The subsequent use of spoil materials must not pose risks for the environment and human health. During the environmental design of the project, it is therefore essential the developing of a site-specific conditioning study for the management of excavation material. In fact, on the basis of the results obtained from the conditioning tests, it is possible to hypothesise a maximum dose of the required conditioning agents, which will constitute the reference for the environmental risk assessment in the context of a sustainable management of spoil materials. Anyway, the management of spoil materials produced from excavation by EPB-TBM is extremely complex and is based on numerous design assumptions, characterized by high levels of uncertainty: from the definition of the commercial products to be used and of the most suitable soil conditioning parameters, to the execution of analysis and tests to be performed (biodegradation and/or ecotoxicological), up to the methods of interpreting the results. The uncertainties connected to the experiments carried out during the design phase can be reflected in: differences in the operational protocols to be adopted during construction, unavailability of the approved project, consequent increase in time and costs to reiterate the site-specific experiments and the following approval process. The environmental legislation on this field, clarifies only partially how to control and manage the substances contained in foaming agents and additives used for the excavation process by EPB-TBM. To overcome the design problem related to the interpretation or absence of regulatory reference limit values for the main substances contained in the additives, site-specific experiments were carried out in some projects, aimed at evaluating the eco-compatibility of the conditioned soils through biodegradation and ecotoxicological studies of the foaming agents.

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Environmental effect of chemicals injected into the soil in mechanized tunneling applications

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In recent years the management of the soils and rocks resulting from the mechanized tunnel excavation process, raised increasing concern in Europe. The need for an amount of conditioned materials, to stabilise the excavated soils, has lead companies, governments and research groups to face economical, technical, logistical and environmental issues. The most widely used technique in mechanized tunnelling, named Earth Pressure Balance (EPB), requires the continuous injection of chemicals during the advancement of the machines to enhance the excavation activity. Depending on the excavated materials features, various foaming and stabilisation agents are used. The environmental design on this field, clarifies only partially how to control and manage the substances contained in foaming agents and additives used for the excavation process by EPB-TBM. To overcome the design problem related to the interpretation or absence of regulatory reference limit values for the main substances contained in the additives, site-specific experiments were carried out in some projects, aimed at evaluating the eco-compatibility of the conditioned soils through biodegradation and ecotoxicological studies of the foaming agents.

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Site-specific protocol to assess the environmental compatibility of spoil materials produced by EPB-TBM

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The increasing use of Earth Pressure Balanced Shields (EPB-TBM) in the tunnelling industry has been due to their advantages over conventional excavation methods, such as continuous operation, safer working conditions, reduced damage at surface level and higher tunnelling speed. The performance of EPB-TBM relies on the use of appropriate soil conditioning foaming agents containing water solutions of surfactants, mainly sodium lauryl ether sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material of excavation processes can be re-used in products if the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C12+; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits in European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its possible ecotoxicological effects on soil and water organisms. The ecological approach here reported, consisting of site-specific studies together with ecotoxicological tests performed on the real excavated soils, aims to fill the gap between the lack of threshold limits in soil and water for these multicomponent commercial products and the environmental protection. The studies are planned following a preliminary evaluation of the foaming agent treatment ratios to be used for the specific lithological characteristics of the excavated soils. Here we report the main steps of the environmental studies useful for producing a “Protocol for the assessment of environmental compatibility of the spoil material during the tunnelling in the construction site”. The aim of the protocol is to address engineering contractors and stakeholders (e.g. Railway and Motorway operators) on how to verify the environmental compatibility of excavated soil before putting it in the destination site. It is very important to highlight that the protocol (e.g. the ecotoxicological test selection) has taken into account the site-specific characteristics and the possible environmental exposure scenarios in order to protect ecosystems and human health.

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Mineral-based soil conditioner for EPB-TBM: An environmentally friendly alternative

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A novel product, based on a natural mineral has been developed for use as a foaming and soil conditioning agent with earth pressure balance (EPB) tunneling machines (TBMs). It is available as readily water dispersible granules or pre-prepared aqueous suspension form and can be dispersed and diluted readily in water with low shear mixing. The resulting dilute suspension can be converted into a foam using an industrial foam generator, or by other mixing methods. It can be used with existing equipment found on EPB-TBMs, without the need for further modifications and investigations. The innovative product (see Figure 1), transport and dispose of the treated material. In the worst case, the uncontrolled chemical injection could lead to the production of several tons of hazardous waste, whose management might be significantly onerous in terms of cost and time. The University of Rome Sapienza and Astaldi started a joint research program with the aim of acquiring aknowledge, data and expertise in the use of natural mineral widely distributed in the earth’s crust. It is virtually insoluble in water and has no known ecotoxicity. Specifically, there is an absence of toxic effects on two aquatic organisms (Danio rerio and Daphnia magna) and a demonstrated low risk to arthropods, earthworms and soil bacteria. In a recent study commissioned with an environmental consultancy, it was considered that excavated soil, in very close proximity to the product and deposited in a licenced waste facility would not pose a risk to the surrounding water environment. Compared with existing products it contains very low levels of synthetic chemicals, relying instead on the natural mineral component to stabilise foams by a completely different mechanism; one that is potentially less susceptible to the degrading influence of soils that can compete for the surfactants that are present in, and that stabilise conventional foaming agents. The product has been tested in an independent environmental laboratory have demonstrated the good stability of the foams produced using the product (half-life measurements of water treatment), and confirmed that mixtures of the foam with fine and coarse grained soils have the desired consistency and cone slump behaviour for EPB tunnelling. A series of specifically developed tests reveal that the addition of foam substantially reduces adhesion of the finer grained soils to metal surfaces. In practice this will translate to a substantial reduction in the clogging potential of excavated clay in the TBM cutter head and spoil conveyors, crucial for maintaining good advance rates. The new product will be attractive to those seeking to minimise the environmental impact of tunnelling projects.

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Quantification of Carbon Nanotubes in Complex Matrices: Possibilities of Electron Microscopy

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Fascinating properties of Carbon Nanotubes (CNTs) allow the development of novel materials with increased functionalities (e.g. reduced weight, increased strength). Nevertheless, CNTs do pose potential environmental and human health risks and reliable methods to quantify CNTs at low concentration in complex matrices are still lacking. In the present study, we developed a unique shape of the CNTs to quantify these materials in complex matrices. Multiwalled CNTs (IRMM 382) suspended in either ultrahigh quality (UHQ) water or in soil
extracts were directly centrifuged on transmission electron microscopy (TEM) grids, resulting in an even distribution of the CNTs on the grids. Samples were investigated with a scanning electron microscope (SEM, Magellan XHR 400, FEI) operated at an acceleration voltage of 20 kV in emission mode and using a bright field transmission electron detector. A ridge detection algorithm implemented in the image processing software Fiji was used to detect and characterize individual CNTs. The area fraction and the number of CNTs were calculated based on the total length of all CNTs (provided by the ridge detection algorithm) detected on the images in combination with their thickness (20 nm), their density (1.4 g cm⁻³) and the well-defined volume of suspension that was centrifuged on the TEM grids. CNTs were well separated on the TEM grids and an increasing number of CNTs was observed on images with increasing concentrations of CNTs in suspension. Plotting the calculated concentration of CNTs in suspension against the nominal CNT concentrations (10 μL⁻¹ – 100 μL⁻¹) resulted in a linear relationship. The calculated and the nominal CNT concentrations were in good agreement at low CNT concentrations, but at high concentrations, the calculated concentrations underestimated the nominal values by a factor of ~2. Almost identical results were obtained from CNTs in UHQ water and in soil extracts (5 μg/g – 1 mg/g), indicating that the detection of the CNTs was not compromised by the presence of soil particles. Future experiments will focus on a selective removal of the soil particles by an additional treatment with diluted hydrofluoric acid. Initial experiments are promising and suggest that the detection limit of the methods can be lowered to 1 mg/CNT)/kg soil), which would represent huge step forward in detecting of CNTs in complex matrices.

449 Monitoring for perfluorinated compounds, insecticides, and brominated flame retardants in the water of Daechung lake and Geum river basin H. Lee, National Institute of Environmental Research (NIER) / Geum River Water Environment Research Center; Y. Cho, J. Han, National Institute of Environmental Research (NIER) / Daegu City and Geuta city environmental research center; B. Lee, National Institute of Environmental Research (NIER) / Han river water environment research center; B. Seol, M. Chae, S. Cheon, National Institute of Environmental Research NIER / Geum River Water Environment Research Center A multidisciplinary analytical method using LC-MS/MS was developed for perfluorinated compounds (PFCs), insecticides, and brominated flame retardants (BFRs) in water samples with the simultaneous SPE method. The ranges of recoveries were 19.7 ~ 135.0 % (PFCs), 95.0 ~ 117.2 % (Insecticides), and 72.5 ~ 86.4% (BFRs), with coefficients of variation of less than 15%. Method detection limit (MDLs) of PFCs, insecticides, and BFRs were 0.3 ~ 7.1 ng/L, 3.0 ~ 3.7 ng/L, and 5.1 ~ 11.7 ng/L, respectively while limit of quantifications (LOQs) were 0.9 ~ 2.7 ng/L, 3.0 ~ 3.7 ng/L, and 15.6 ~ 35.0 ng/L. For understanding the background levels of PFCs, insecticides, and BFRs in the river water, those compounds were monitored in Geum river main stream, So-ok stream, Juwon stream, and Daechung lake (Dam) every month (March to December) utilizing the developed method. The compounds of the highest detection frequency were PFPA, PFHxA, and dinotefuran (Insecticide), whereas BFRs were detected only in March and December, except for main stream. In conclusion, the trends were not observed on periodical and spatial characteristics and the background levels were secured for PFCs, insecticides, and BFRs in Geum river basin.

450 Impacts of Contaminants of Emerging Concern on Terrestrial Organisms Stacia Dudley 1, Marcus Pennington 1, Chenliang Sun 2, John Trumble 3, Jay Gan 4 1Environmental Toxicology Graduate Program, University of California, Riverside, CA 2Department of Environmental Sciences, University of California, Riverside, CA 3Department of Entomology, University of California, Riverside, CA reclaimed water is a historically underutilized resource. However, with increased population growth and global climate change placing increased pressure on fresh water supplies, urban developments evolve into sustainable means to meet the needs of citizens, industries, and agriculture. The use of recycled water for agriculture comes with the potential risk of environmental and food contamination by contaminants of emerging concern (CECs). These compounds pose a potential threat to the health of ecosystems because they are designed to be biologically active at low concentrations and are considered “pseudo-persistent” due to their capacity to contaminate the environment over a large mass spectrometry. 13C tracing, enzyme extraction and Illumina sequencing techniques, we evaluated a wide range of biological effects in terrestrial organism caused by exposure to CECs. Organisms in these studies included, the cabbage looper (Trichoplusia ni), an earthworm (Eisienia fetida), a model plant (Arabidopsis thaliana) and cucumbers (Cucumis sativus), radishes (Raphanus sativus), and tomatoes (Solanum lycopersicum). These studies have revealed a multitude of effects including increased mortality and development time, reduction in weight, changes to the microbiome and up-regulation of enzymes associated with oxidative stress. Further, the study has highlighted the potential for higher plants to take up, translocate and detoxify CECs.

451 Occurrence of pharmaceuticals and their metabolites in Euthynnus alletteratus bile J.M. Peña Herrera, Institute of Environmental Assessment and Water Research (IDAIA-CSIC) / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agroambientali e territoriali; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. Navarro, IDAEA CSIC / Dept. Recursos marinos renovables; M. Solé, ICM-CSIC; S. Perez, IDAEA CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry To date, there are limited data on the occurrence of pharmaceuticals in surface water has been attributed to the effluents of WWTP among others. The widespread occurrence of pharmaceuticals in the aquatic environment has raised concerns about their potential adverse effects on exposed wildlife. Little is currently known on exposure levels of drugs in fish, but some studies reported the detection of pharmaceuticals and endocrine disrupting compounds in this type of biota. Due to possible accumulation processes, pharmaceuticals and metabolites could be thousand times more concentrated in fish than in polluted living waters. By other hand, fish are known to possess a hepatic detoxification system which are likely capable of metabolizing pharmaceuticals taken up from polluted waters. Some studies proposed the analysis of bile from fish to evaluate pharmaceuticals exposure including the identification of metabolites by UPLC-HRMS. In this context, we propose the evaluation of the metabolism of frequently detected drugs in fish, performing a rapid screening of bile by HR-MS for the presence of stable intermediates. Fish were collected from different regions in the Mediterranean coast of Spain. Afterwards, their bile was isolated from the fish and analyzed for the detection of parent drugs and some metabolites listed in an in-house suspected list. A sampling campaign was planned to collect tuna fish, Euthynnus alletteratus, from the Mediterranean coast of Spain: Tarragona, Barcelona and Palma de Mallorca. A total of 452 tuna samples were analyzed directly by UPLC-HRMS after a protein precipitation. The HRMS data allowed screening for suspected pharmaceuticals and their metabolites and provided plausible chemical formulae. The comparison of MS/MS spectra of the parent compounds and their metabolites allowed to propose chemical structures for possible metabolites in fish bile. With this analytical methodology some metabolites, corresponding to different reactions that includes products of hydroxylation, glucuronide conjugates were identified. The suspect analysis of bile samples allowed the detection of several pharmaceuticals. Psycho-active drugs were one of the most commonly detected drugs. Their identities were proposed by matching their accurate MS and MS/MS data against different libraries. Finally, authentic standards were employed to confirm the proposed drug identities and to determine analyze concentrations in the fish samples.
453 Root-uptake and dissipation of atenolol, sulfamethoxazole and carbamazepine applied as a single compound solution or in mixture of all compounds in three soils and five plants  
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This study was focused on a root uptake of carbamazepine, atenolol and sulfamethoxazole from 3 soils: Hablic Chernozem, Hablic Cambisol and Arenosol Episetric. Five plants (radish, arugula, lettuce, spinach and green peas) planted in those soil were initially irrigated by fresh water and next with water contaminated by a single compound or their mixture. After 3 or 4 weeks, each plant was divided into separate parts: roots (including bulbs of radish), leaves, stems (green peas) and pods (green peas). Plant parts and soils were freeze-dried and dry-masses and concentrations of pharmaceuticals and their metabolites were measured. Despite that atenolol and sulfamethoxazole relatively rapidly dissipate from soils, they and metabolites of atenolol were detected in all plants. Carbamazepine is very stable in soils and fractions of its metabolites are usually low. However, very high concentrations in all plants were measured not only for carbamazepine but also for its metabolites. The degree of compounds’ transformation depended on a plant family. Considerably higher concentrations of atenolol, sulfamethoxazole and metabolites of atenolol were measured in roots in comparison to those in leaves and soils. In the case of carbamazepine, the highest concentrations were measured in leaves followed by roots and soils. Both indicate a high potential of plants to accumulate studied pharmaceuticals in their bodies and a high ability to transform studied compounds. Particularly in the case of carbamazepine, the considerably higher concentrations of metabolites were measured in leaves in comparison to concentrations in roots and very low or negligible concentrations in soils. Transformation of compounds in plant bodies is attributed to enzymes CYP450. Larger concentrations of carbamazepine metabolites were measured in leaves of lettuce, spinach and green peas than in leaves of radish and arugula (Order – Brassicales, Family – Brassicaceae). Oxcarbazepine was detected only in plants (not in soils). Antibiotic sulfamethoxazole likely induced dissipation of other two compounds in soils, which increased relative concentrations of compounds in plants (i.e., concentrations of compound in plant divided by compound loads in soils that is a total amount of applied solution divided by a dry mass of soil).

Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (II)

454 Inter-individual variation in the bioavailability and effects of NSAIDs in fish  
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A basic tenet in the environmental risk assessment of pharmaceuticals is that pharmacological effects will occur in advance of any adverse effects, if their molecular targets are conserved in wildlife and if circulating blood plasma concentrations approach therapeutic concentrations established in humans. Fish generally display high levels of conservation of human drug targets and may be exposed to pharmaceuticals via exchanges from wastewater treatment plants. The Non-Steroidal Anti-inflammatory Drugs (NSAIDs) ibuprofen and diclofenac are present in effluents, resulting in low mg/L concentrations in surface waters and fish blood plasma below or bordering on "therapeutic" concentrations. However, some studies suggest that diclofenac and ibuprofen can induce harmful effects in fish at measured environmental concentrations. Here we seek to refine the understanding of the effects of NSAIDs by gaining greater understanding of their bioavailability, pharmacologically effective concentrations and inter-individual variations in fish. We quantified plasma prostaglandin (PG) and plasma NSAID concentrations in individual female rainbow trout during and after 12 days continuous flow-through exposures to ibuprofen (0, 10, 200 mg/L) or diclofenac (0, 5, 100 mg/L). High-level NSAID exposures significantly reduced plasma PGE2 concentrations, but had little pharmacologically effective influence on PGE2 levels, exposures due in part to considerable inter-individual variation in plasma PGE2: 2.6-143 pM for ibuprofen; 0.8-188 pM for diclofenac; versus 0.8-316 pM in control fish. There was no significant correlation between plasma PG and plasma NSAID concentrations within exposure treatments; plasma NSAID concentrations exhibited much lower inter-individual variation, with blood plasma: water partition coefficients ranging from 1-3 for ibuprofen and 1-9 for diclofenac. To identify factors affecting PG levels in individual fish we measured plasma lipid content and plasma protein binding influencing partitioning and bioavailability, haematocrit and pro-inflammatory and re-active protein concentration quantifying baseline immune system status, and plasma cortisol concentrations as a measure of stress in fish, potentially affecting plasma NSAID and PG concentrations. From our analyses, no single factor could explain the observed variations in NSAID uptake and pharmacological response. Our data highlight some of the complexities in interpreting biological exposure and effects data for NSAIDs.

455 Environmental effect assessment of human pharmaceuticals - the regulatory way forward  
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Environmental Risk Assessment of Pharmaceuticals; S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals; I. Rönnefahrt, German Environment Agency - UBA / Section IV 2.2 Pharmaceuticals

Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/447/02/Rev.2) was adopted in 2006 and is currently under revision. Input has been provided by several stakeholders from academia, industry and government. In this context, the UBA experiences with effect based assessment of human pharmaceuticals will be evaluated and presented. The basis for the evaluation are double quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Based on the own protestations, the approach was set up for the EMA UBA. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 ng/L) for effect data justification. The quotient between the effect values of most sensitive and most insensitive species in more than 20% of the evaluated cases is greater than 100. Fish are the most sensitive organism group in more than half of the cases. In this context, the proposed approach of replacing long-term exposure data by short-term exposure factors as applied usually for chemicals without any specific mode of action will be analyzed.

456 Prioritising human health risk of environmental residues of pharmaceuticals and personal care products in use in southern Nigeria  
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Pharmaceutical and personal care products (PPCPs) are used worldwide for medical treatment and personal hygiene. PPCP residues are usually discharged into the environment during wastewater treatment. The environmental fate of these chemicals is poorly understood, leading to concerns about potential health effects and ecological impact posed by their use and release. In many developing countries, information regarding the consumption patterns of PPCPs is often limited, even though consumer product usage data are crucial for more realistic exposure estimates, like carcinogenic and anti-cancer drugs. Furthermore, the evaluated data allow discussion about their potential impact on several taxonomic groups, as well as about the PEC action limit (10 ng/L) for effect data justification. The quotient between the effect values of most sensitive and most insensitive species in more than 20% of the evaluated cases is greater than 100. Fish are the most sensitive organism group in more than half of the cases. In this context, the proposed approach of replacing long-term exposure data by short-term exposure factors as applied usually for chemicals without any specific mode of action will be analyzed.
ciprofloxacin, ampicillin, clocaxicillin, sulfaethoxazole, trimethoprim and pseudoeuhideine) and 4 IPC ingredients (sodium lauryl ether sulphate, alcohol ethoxylates, ammonium thiglyolactate and dhichlo.) This is the first attempt to prioritize PPCPs in Nigeria and it provides a useful priority set of chemicals for source water monitoring in the region. Future work will focus on evaluating the results of the prioritisation approach against real world monitoring data for Nigeria.

457 Aquatic toxicity related to pharmacological or secondary targets of human pharmaceuticals A. Coors, ECT Oekotoxikologie GmbH; A. Falkenhain, Ch. Brüggemann, ECT Oekotoxikologie GmbH; M. Scheurer, DGW Water Technology Center / Analysis and Water Quality Evaluation (Lueneburg), Germany

Human pharmaceuticals target specific biological structures to exhibit their intended therapeutic effect. The presence of the anticipated biological target of a pharmaceutical in a non-target species may lead to specific effects in that organism, while in the absence of the target non-specific baseline toxicity such as narcosis would prevail. Yet, pharmaceuticals often do not only interact with the anticipated pharmacological target in patients, but can also interact with secondary targets. Hence, specific toxicity could occur in non-target species also in the absence of a conserved pharmacological target simply because the secondary target is conserved in that species. The present study explores this hypothesis testing anti-histamines as model substances in Daphnia magna and the green algae Raphidocelis subcapitata. Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative Joint Undertaking (2007-2013) and EFPIA companies’ in kind contribution.

460 Neurotoxicity testing approach to investigate venlafaxine and oxazepam modulation of transcriptomics and behavioral profiles in zebrafish embryos and larvae C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; A. Haigis, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis ESA; R. Hamann, Fraunhofer IME; S. Wuester, Institute for Environmental Research RWTH Aachen; M. Krauss, Helmholtz centre for Environmental Research UFZ Eawag-EFPL / Department of Anatomy Physiology and Cell Biology; H. Hollert, Eawag-EFPL / Institute for Environment Research.

Neuroactive pharmaceuticals are of growing concern as aquatic contaminants due to environmental and human risk. Yet, pharmaceuticals often do not only interact with the anticipated pharmacological target in patients, but can also interact with secondary targets. Hence, specific toxicity could occur in non-target species also in the absence of a conserved pharmacological target simply because the secondary target is conserved in that species. The present study explores this hypothesis testing anti-histamines as model substances in Daphnia magna and the green algae Raphidocelis subcapitata. Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative Joint Undertaking (2007-2013) and EFPIA companies’ in kind contribution.

458 Neurotoxicity testing approach to investigate venlafaxine and oxazepam modulation of transcriptomics and behavioral profiles in zebrafish embryos and larvae C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; A. Haigis, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis ESA; R. Hamann, Fraunhofer IME; S. Wuester, Institute for Environmental Research RWTH Aachen; M. Krauss, Helmholtz centre for Environmental research - UFZ / Effect-Directed Analysis; M. Fenske, Fraunhofer Gesellschaft / Translational Medicine and Pharmacology; I. Werner, Ecotoc Centre Eawag-EFPL / Department of Anatomy Physiology and Cell Biology; H. Hollert, Eawag-EFPL / Institute for Environment Research.

Neuroactive pharmaceuticals are of growing concern as aquatic contaminants due to environmental and human health risks. Even low concentrations can interfere with molecular pathways and population-relevant behaviors. At the same time there is no EU regulatory framework for environmental neurotoxicity assessment. This project aimed to contribute for establishing a neurotoxicity testing approach by integrating molecular (transcriptomics) and functional (behavioral) endpoints. Eawag grant agreement n° 115735, resources of which are composed of financial contribution from the European Union’s Seventh Framework Programme (FP7/2007-2013) and EFPIA companies’ in kind contribution.

459 Virtual fish tales: Liver, Intestinal and Gill Organoids as an in vitro alternative to live fish for prioritising pharmaceuticals and other compounds of highest concern in the environment.

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Pharmaceuticals enter the aquatic environment largely through patient use, and result in a pseudo- persistent background in the aquatic environment. The risk of these compounds is assessed for new products registered since 2006, but there is a legacy of essential medicines for which we need to understand more. Since most of the thousand or so pharmaceuticals used by patients are likely to pose little environmental risk, it is important to identify those of most concern in order to prioritise effort and resources; it is vital to be able to predict internal concentrations in aquatic organisms. One method to assess uptake potential is to expose the animals of most concern. However, there are potentially thousands of compounds to be prioritised. Factoring that we already know the uptake rate can be influenced by the concentration of the compound in the water, there are enormous ethical implications for conducting this work with live animals (fish), and significant cost of resources to practically conduct the work. Alternatives are clearly required. Significant efforts to better predict environmental exposure are underway as part of the iPE project (IM grant no 115735—IBP). These in silico methods provide a first tier of screening, but we are likely still faced with hundreds of compounds to assess at multiple concentrations. We have been developing in vitro tissue micro-organisms (organoids) that replicate the in vivo tissue. These can be used to build a virtual fish that will allow the screening of pharmaceuticals (or other compounds of concern or even metals) without testing live fish (BBSCR/NERC grant BB/L01016X/1). By building fish tissue cultures that better represent the complexity of the in vivo situation, we are able to offer in vitro models that can simulate live fish. Water exposure to the gill model can now be tolerated (without compromise) for several weeks, intestinal models are similarly robust. Since both methods employ a permeable barrier culture, rates of flux can be measured that provide not only simple information such as a compound may be taken up, but also rates of uptake and excretion. These data can be used to build kinetic models. The liver spheroids provide a metabolic tissue that when used in co-culture with the gill or gut provide a simple virtual fish alternative to live fish. These methods offer a critical step between predicting compounds of highest concern and prioritising which require further testing.

Emergence and multidimensional interactions of engineered nanoparticles in toxicology

460 Effects of fullerene C60 increasing concentrations in Mytilus galloprovincialis: role of mTOR in cellular/tissue alterations S. Sforzini, Universita Del Piemonte Orientale Amadeo Avogadro / Department of Chemistry and Toxicology University of Plymouth / Biogeochemistry Research Centre; Y. Aminot, University of Plymouth / Department of Chemistry; A. Barranger, University of Plymouth / School of Biological Sciences; J.W. Readman, University of Plymouth / Biochemistry Research Centre; Y. Aminot, University of Plymouth; A.N. Ha, University / Biological Sciences; M. Banni, Laboratory of Biochemical and Environmental Toxicology; A. Viarengo, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Laboratory of Environmental Chemistry and Toxicology

Little is known about the effects at cellular, tissue and individual levels of emerging contaminants such as fullerenes. In particular, the mode of action of fullerene C60 is poorly investigated. In this research, the effects of C60 on mTOR (mechanistic Target of Rapamycin) activity in mussel digestive gland were studied. mTOR is an evolutionarily-conserved serine/threonine protein kinase that senses and integrates a variety of cellular physiological and environmental signals to regulate cell growth. mTOR is found in two functionally distinct complexes, mTORC1 and mTORC2. In particular, the phosphorylated active form of mTORC1 mediates temporal control of cell growth by activating anabolic processes (such as transcription, ribosome biogenesis, protein synthesis), and by inhibiting catabolic processes (such as autophagy); mTORC2 is primarily involved in actin growth. mTOR is found in two functionally distinct complexes, mTORC1 and mTORC2. In particular, the phosphorylated active form of mTORC1 mediates temporal control of cell growth by activating anabolic processes (such as transcription, ribosome biogenesis, protein synthesis), and by inhibiting catabolic processes (such as autophagy); mTORC2 is primarily involved in actin growth.
461 Protoplastic responses to nanoparticle and ionic silver in freshwater microbes with different background
D. Barros, Universidade do Minho / Centre of Molecular and Environmental Biology; D. Pradhan, University of Minho / Department of Biology; P.M. Santos, C. Pascoal, F. Cassio, University of Minho / Centre of Molecular and Environmental Biology CBMA Department of Biology. Enhanced use of AgNPs (-AgNPs) has inevitably resulted in their release into freshwater raising concern about the risk to non-target biota and related ecological functions. Functional protoplastics is an emerging technology that provides high-throughput analyses augmenting measurements of direct and highly sensitive responses at the cellular and sub-cellular levels. The impacts of AgNPs and ionic Ag at EC50 (effective concentration) were assessed based on the variations in the overall protoplasts in two aquatic fungal strains of Atrichospora tectulaudia, one isolated from a non-polluted stream (At72) and the other from a metal-polluted stream (At61), and ii) the bacterial strain Pseudomonas sp. M1 (PsM1) isolated from a metal-polluted stream. At72 was the most sensitive to AgNPs, whereas PsM1 was the most tolerant one. Characterization of AgNPs showed increased particle stability and lesser agglomeration with time in At72 while for At61 and PsM1 there was an increase in AgNPs agglomeration explaining its lower impacts on their growth. In fungi, >40% of the total quantified proteins were significantly altered after exposure to AgNPs and/or Ag+ whereas for PsM1 this percentage was lower (∼20%). At72 and At61 shared only 20% of the proteins suggesting that the biological pathways involved in Ag+ and AgNPs exposure were different. At61 had >25% more proteins induced by both Ag forms (compared to At72), suggesting higher response which is consistent with the background of this fungal strain. In PsM1, 32% of the proteins increased under exposure to AgNPs whereas the percentage for Ag+ was higher (68%) indicating different responses to Ag+ and/or AgNPs. In At72, Ag+ increased the content of proteins involved in protein homeostasis while AgNPs increased the content of proteins related to DNA repair, the transport of substances and energy production. In At61, AgNPs increased the content of proteins involved in protein synthesis and energy production while both forms of Ag increased the content of proteins related to cell-redox and protein homeostasis, biomass and spores production and also to nucleic acids metabolism. Both Ag forms induced stress-responsive proteins which was consistent with the responses of enzymes involved in oxidative stress. Overall, functional protoplastics can be useful to get a mechanistic insight on the stress induced by AgNPs and/or Ag+ in microbes that play key roles in freshwater ecosystems.

462 Hazard assessment of seven different commercial silica nanoparticles on a battery of test species: bacteria, algae and fish cell lines
F. Magno, University of Minho / Centre of Biological and Environmental Sciences; J. Sturve, Gotteborg University / Department of Biological and Environmental sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences. Manufactured silica nanomaterials are widely used in numerous applications in society such as paints, coatings, cosmetics, textiles and food and its release into the environment is increasing. This has raised concerns regarding the risk of silica nanomaterials and was in 2010 selected as one of the priority substances by the OECD Working Party on Manufactured Nanomaterials. In order to thoroughly examine the toxicity of silica nanomaterials to deuterants, primary producers and fish, a panel of seven well characterized (with different size, coating and charge), biocide free, silica nanomaterials, were tested on bacteria, algae and fish cell lines. Based on the result, the current study also examined the selection of an appropriate exposure metric comparing mass (mg/L), number of particles (NoL) and surface area (m²/ L) against the observed toxicity. The results show that gill cell lines were the most sensitive test model with the lowest reported EC20 value of 5.1 mg/L after exposure to the smallest particle at a concentration range of 12.5-100mg/L. Toxicity to fish cells was determined to be surface dependent, except for particles coated with epoxy silane, which did not show toxicity. For bacteria and algae, the cell wall seems to play a major role in the uptake and toxicity of silica nanoparticles. Keywords: hazard assessment, silica nanoparticles.

463 Toxicity Assessment of Engineered Titanium Dioxide Nanoparticles
S. Bitragunta, Birla Institute of Technology & Science Pilani, Hyderabad Campus / Biological Sciences; S. Pelani, Birla Institute of Technology & Science, Hyderabad Campus / Biological Sciences. Titanium dioxide engineered nanoparticles (TiO₂-ENP) are extensively employed in manufacturing of cosmetics, pharmaceuticals and health care products. As a result, TiO₂-ENP can reach the ultimate sink such as soil in the environment during their life cycle. In this context, investigations to understand environmental implications of nanoparticles including TiO₂-ENP are gaining prominence across the globe. In the backdrop of assessment toxicity of rutile TiO₂-ENP (r-TiO₂-ENP) in soil sentinels, present study is aimed at evaluating their toxicity as per OECD-207 guidelines on earthworm, Eisenia fetida. Physicochemical characterization of r-TiO₂-ENP using dynamic light scattering revealed their tendency to form agglomerates (330-480 d.nm) in water. Soil exposure of earthworms to r-TiO₂-ENP (0.1, 0.15, 0.2 and 0.25 mg/kg) showed no mortality after 48 h. Increased specific activities of antioxidant enzymes including catalase, superoxide dismutase and glutathione peroxidase as well as lipid peroxidation indicate the potential of r-TiO₂-ENP to induce oxidative stress in the sentinel organism. Interpretations of the study can serve as cues to design a comprehensive approach for developing invertebrate based biomarkers and indicators as early warnings for assessing environment and health impacts of engineered nanoparticles.

464 Combination effects of chlorpyriphos and ZnO on oxidative stress and reproduction of the earthworm Dendrobaena veneta
D. Hackenberger, Department I Biology, University of Osijek / Department of Biology; L. Mandarić, University of Osijek / Department of Biology; D. Marković, University of Rijeka / Department of Biotechnology; O. Obodžić, Rudjer Boskovic Institute; B. Hackenberger, Department I Biology, University of Osijek / Department of Biology. When assessing the toxicity of pesticides and other chemicals to non-target organisms the most common experimental set-up is an exposure to a single compound. However, it is more likely for organisms under the environmental conditions to be exposed to a combination of chemicals. The aim of the study was to investigate the effects of mixtures of ZnO and chlorpyriphos (CHP) on biochemical biomarkers and reproductive success of the earthworm Dendrobaena veneta with possible differences in effects of ZnO in nano and bulk form, and the difference of effects in various soils. EC50 values for reproduction of D. veneta after exposure to CHP and ZnO were calculated and used in the binary toxicity experiment. Concentrations were as follows, with EC50 being 100%: 100% CHP, 75% CHP/25% ZnO, 50% CHP/50% ZnO, 25% CHP/75% ZnO, 100% ZnO. ZnO was separately tested as bulk and nano sized particles and CHP was tested as a commercial preparations. The entire experiment was conducted according to the OECD earthworm reproduction test. At the end of the experiment the number of juveniles and activities of AChE, CAT, GST, TBARS, MT and PC were measured. The concentrations of pesticides in soil samples were measured with UPLC and the concentrations of Zn was measured with the energy dispersive x-ray fluorescence technique (EDXRF). CHP had a clear effect on AChE activity with almost 50% inhibition after 28 days of exposure in artificial soil. CAT activity did not change on any of the treatments, for both ZnO and ZnO nano, while GST activity decreased. The number of juveniles was significantly reduced with all mixture ratios. In natural soil CAT activity was also unaffected with bZn, and slightly induced with ZnO/CCHP combination. The inhibition of AChE was present at all applied combinations. In natural soil the number of juveniles was reduced with ZnO, while it remained the same as control after bZnO exposure. The effects of combined exposure of CHP and ZnO were depending on the stoichiometry of the mixture, on the characteristics of the soil in which the earthworms were exposed. Moreover biomarkers should be employed to elucidate which low-level biomarker can be linked with the effects on the reproductive level.

465 Poster spotlight: WE305, WE323, WE324

Improving the environmental risk assessment of the aquaculture 'Blue Revolution'

466 Tools for Assessment and Planning of Aquaculture Sustainability (TAPAS)
P. van den Brink, Alterra and Wageningen University; A. Lillcrap, NIVA Norwegian Institute for Water Research / Ecotoxicology; A.L. Macken, Norwegian Institute for Water Research / NIVA; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; T.C. Telfer, University of Stirling Aquaculture is a major food production subsector which will play a major role in filling the growing seafood supply gap, estimated to be of the order of 47.5 million tons by 2050. However, aquaculture cannot be practiced everywhere; it requires a filling the growing seafood supply gap, estimated to be of the order of 47.5 million tons by 2050. However, aquaculture cannot be practiced everywhere; it requires a

Inland and coastal resources are essential to maintaining in existing and future aquaculture systems. Consequently, suitable zoning, selection of sites and application of carrying capacity are among the most important issues for the future success of European aquaculture, and also predicate the need for sustainability, resilience and best practice guidelines, as provided by the Ecosystem Approach to Aquaculture. The four-year Horizon 2020 TAPAS research project, which started in March 2016, aims to consolidate the environmental sustainability of European
aquaculture by developing tools, approaches and frameworks to support EU Member States in establishing a coherent and efficient regulatory framework, implementing the Strategic Guidelines for the sustainable development of European aquaculture and delivering a technology and decision framework for sustainable growth. The ultimate goal of the project is to create cost-efficient management tools and practices for the European aquaculture sector to investigate the scope of fish farming activity, social interactions, potential environmental impacts and any future risks.

467 Preliminary investigation on the occurrence of multifunctional organic micropollutants in offshore seawater and fish farm L. Lin, National Institute of Oceanography, Singapore; G. Lin, National University of Singapore / Civil & Environmental Engineering

Limited research has been conducted on the occurrence and distribution of antibiotics, pharmaceuticals, personal care products, endocrine disrupting chemicals and artificial sweeteners in the marine environment despite being increasingly impacted by these micropolllutants (MPs). In this study, the presence and distribution of multifunctional organic micropolllutants occurring in 14 different groups were investigated in offshore seawaters and fish farms of Singapore. The sampling area is affected by various anthropogenic pressures including treated effluents, fish farming, shipping and port activities. A total of 23 MPs were found in offshore seawaters, 9 of them with detection frequencies higher than 50%. The highest detected values corresponded to cyclamant, salicylic acid and sucralose, with concentration range of

468 Perspectives on Urbanization, Water Reuse, and Aquaculture Product Quality B. Beylich, NIVA / Ecotoxicology and Risk Assessment; L. Conkle, Texas A&M University Corpus Christi / Physical and Environmental Science

By 2050, it is estimated that global food production must increase by 50%. Aquaculture will play an important role to meet these needs. For example, in 2014 aquaculture surpassed global fisheries in providing food for human consumption. It is important to note that global aquaculture activities can in urban and periurban regions with differential waste management capacity. Yet high population densities in urbanizing regions result in concentration of food, energy, water and other resource consumption. Urbanization also leads to concentration of chemical use, which inherently results in exposures to human populations and ecosystems receiving waste streams within and from these urban centers. In developing nations, where many of the megacities will continue to emerge over the next few decades, antibiotic use is increasing faster than public health interventions and environmental management systems are being implemented. Unfortunately, 80% of the global sewage treatment is not treated, but returned to the environment and thus reused for various purposes. These non-traditional reused waters are being recycled for agriculture, including aquaculture in areas experiencing rapid urbanization, yet implications for water security, food safety and international trade are not routinely examined to manage more sustainable aquaculture practices. In the current presentation we draw from our ongoing efforts in Asia and North America to understand bioaccumulation of organic contaminants of emerging concern in common fish and shellfish used for aquaculture. For example, we have observed aquacultured bivalves to accumulate diverse contaminants of concern (e.g., pharmaceuticals, pesticides, flame retardants), apparently from landfill leachates and effluent discharges of marginal quality, in Hong Kong. Our findings from laboratory uptake and depuration studies with channel catfish and tilapia focus on contaminants with diverse physico-chemical properties (e.g., weak base medicine, phosphorus-based flame retardant, perfluorinated compound, cyanotoxin) and provide an approach to improve aquaculture practice and to support bioaccumulation assessments for chemicals falling outside of applicability domains for nonionizable organic contaminants. In North America we are examining intersections among water reuse practices and aquaculture for various products. Such efforts appear warranted at the global scale.

469 Bioaccumulation of selected veterinary medicines in the blue mussel (Mytilus edulis)

S. Brooks, NIVA / Ecotoxicology and Risk Assessment; B. Beylich, NIVA; A. Ruus, NIVA / NIVA; J. Rundberget, NIVA; A. Lillcrap, NIVA / Ecotoxicology and Risk Assessment

Veterinary medicines are widely used within the fish farming industry for the control of sea lice infestation. In 2016, over 10 tonnes of veterinary medicines were used by Norwegian fish farms for the control of sea lice. The impact on non-target species has raised increasing concern. For instance, do wild and farmed mussels in the vicinity to these fish farms have the potential to bioaccumulate these chemicals and thereby pose a threat to human health? On the other hand, mussels may be the most suitable biomonitoring species for the presence of veterinary medicines in the environment. To better understand these scenarios, and the fate of these chemicals in the environment, a series of laboratory controlled exposures were performed to determine the bioaccumulation and depuration of selected veterinary medicines in the blue mussel (Mytilus edulis). The veterinary medicines included teflubenzuron, emamectin, deltamethrin and azamethiphos. Due to the low solubility of teflubenzuron and deltamethrin a saturation column was employed within a flow-through system to deliver a stable concentration of test chemical over a 14-day uptake phase. Water and mussel samples were collected at time intervals during the 14-day uptake phase, and again following transfer of the mussels into clean flowing seawater. The effects of salinity on the bioaccumulation of teflubenzuron also showed lower bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of emamectin was observed after 7 days in clean flowing seawater. The results suggest that mussels are a suitable biomonitoring species for the presence of veterinary medicines in the environment. Additionally, mussel farms in close proximity to fish farms have the potential to bioaccumulate these chemicals in their tissues and is subsequently recommended for monitoring.

470 Contribution of nuclear applications to better understand bioaccumulation of contaminants in aquaculture species

M. Mertian, IAEA-EL / Radioecology Lab; S. Prou, F. Oberhansli, International Atomic Energy Agency / Radioecology Lab

Limited research has been conducted on the occurrence and distribution of emamectin, deltamethrin and azamethiphos, with concentration range of ~1500 ng/g after 10 days. Depuration of teflubenzuron was fast for the first 2 days, although still present at approximately 250 ng/g after 7 days depuration. Salinity had no apparent effect on the bioaccumulation of teflubenzuron. In contrast, emamectin showed lower bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of emamectin was observed after 7 days in clean flowing seawater. The results suggest that mussels are a suitable biomonitoring species for the presence of veterinary medicines in the environment. Additionally, mussel farms in close proximity to fish farms have the potential to bioaccumulate these chemicals in their tissues and is subsequently recommended for monitoring.
presence was also correlated with the food availability, although no evident effects of the antibiotics were found over the analyzed samples. Bioaccumulation of the antibiotics were explored after exposure of 14 hours along an increasing gradient of 5 concentrations (from 0.69 to 6.63 µg/L, 5 replicates). Within a dedicated workflow, we selected the responsive molecular pathways/transcripts before we derived concentration response curves for each of them and we derived a sensitivity value from each curve (even the non-monotonic one). Molecular items showed mainly non-signoid and even non-monotonic responses to triclosan exposure. For example, the transcripts data were mainly best described by an exponential model for more than half of the curves and a Gaussian or log-Gaussian model for more than a quarter of the curves. Then, the molecular items were linked (when possible) to the pathways they are involved in. From that information, we built a SSD-like tool based on functional responses captured at the community level in order to protect function integrity and inferences two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.

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Sex, drugs and Daphnia magna. A multi-omics approach suggests conserved mechanisms of interaction between metallohormones and endocrine disruptors
I. Csammany-Gutierrez, University of Liverpool / Computational Biology Facility; F. Fauchart, University of Liverpool / Institute of Integrative Biology; L. Verhauw, The University of Birmingham / School of Biosciences; K. Gruntzalis, The University of Birmingham; M.R. Viant, University of Birmingham / School of Biosciences; F. Fauchart, University of Liverpool / Institute of Integrative Biology
The assessment of environmental exposure to toxic chemicals released by human activity as well as their impact on biological systems is key to protect the biosphere. Current toxicological methods are based on chemicals specific toxicity assessment of single compounds and assessment of biodiversity. Although this has been a very effective strategy, it has some shortcomings. These include the fact that a relatively limited number of compounds can be measured and linked to biologically relevant organism-level responses. The issue is particularly challenging in chronic exposures and in complex mixtures scenarios. This project aims at identifying the molecular networks linked to single and mixture exposures and to use these to infer the effects of chemical mixtures. We approached this important challenge by applying a systems biology approach to integrate expression profiling, metabolomics and phenotypic data (respiration and feeding rates), representing the response of Daphnia magna to a panel of environmentally relevant chemicals and their mixtures. Firstly, it was exposed to a battery of single compounds with known mode of action (MoA) i.e. estrogen disruptors and acetylcholine esterase (AChE) inhibitors as well as metals with unclassified MoA. We have been able to model the differences between the two main MoA studied and linked them to biological activities within Daphnia. Furthermore, we have found that as expected, metals do not show a common MoA, with some of them clustering closer to either estrogenic disruptors or AChE inhibitors (AChEi). Within the framework of endocrine disruptors, has already been shown to play a role with the estrogen receptor in humans but its role in D. magna is still under surveillance. To further study this finding we exposed D. magna to complex mixtures of Cd and ethinylestradiol. While the individual exposures triggered the alteration of expression of a relatively large number of genes, the exposure to the mixture showed little or no effect. These results indicated that both compounds share a complex interaction at a molecular level suggesting that the degree of conservation of the regulatory pathways underlying response to endocrine disruptors may be higher than previously thought. Overall, our work shows that it is possible to predict a compound MoA from its systems ecotoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (II)
A major goal in the field of toxicology is to predict long term animal health risks and/or environmental hazards associated with a particular substance(s). Traditionally utilised classical toxicology methods involve animal exposure over a relatively short period and recording adverse outcomes. These data are then extrapolated to human effects and to other species. The accuracy of such extrapolation would benefit from mechanistic understanding of toxicity. However, molecular basis for adverse outcomes is not easily interpreted from classical toxicology methods. Here we present our systems toxicology approach that focuses on deciphering biological mechanisms responsible for adverse outcomes. The underlying structure of this approach is a computable biological network model. We have developed two models describing molecular pathways that lead to cardiovascularity and neurotoxicity in zebrafish larvae based on the knowledge curated from scientific literature. Key signalling nodes in the model are linked to information about downstream gene expression. Differential expression of downstream genes can be used to infer activity of the upstream protein – a process termed network scoring. Scoring of the network highlights the most affected nodes, which leads to mechanistic hypothesis generation and gives a quantifiable measure of network perturbation. In parallel to network scoring, we utilize classical toxicology methods to detect adverse outcomes. We present the acute toxicity results for selected chemicals (e.g. acrylamide, arsenic, citalopram, imidacloprid) according to the OECD fish embryo acute toxicity test (OECD test guideline 236). We then report results from chemically exposed larvae in functional cardiac and behavioural assays, and transcriptomics analyses. Finally, we describe the utility of the network model in interpreting transcriptomics analyses to gain mechanistic insight into the molecular events initiated by a given chemical. Cardiac and neural apical endpoints together with computational network scoring provide a comprehensive method for linking molecular events to organ toxicity. This approach will enable more accurate toxicity predictions over long exposures and in different species.

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Time response relationship between gene expression and life history in a Daphnia population exposed to heavy metals
J. Asselman, I. Semmouri, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology / GhEnToxLab unit; K. De Schampaefere, Ghent University (UGent) / Applied Ecology and Environmental Biology
Over the last decade, molecular technologies have evolved into robust high throughput platforms available to many scientists in a wide variety of disciplines. Implementation of these technologies in ecotoxicology and risk assessments have focused on mechanisms of toxicity and stress response on the gene level to explain effects at the organism level. However, current studies remain focused at the individual level and rarely include population level molecular responses. Population level molecular responses may provide a better insight into the potential mechanisms at play at the population level while at the same time avoid focusing on gene expression patterns that are the cause of clonal or interindividual variation. Furthermore, most studies select an arbitrary timepoint to measure gene expression and the resulting information about downstream gene expression. Differential expression of some shortco
molecular state and also predict additive or synergistic effects of mixture exposure.

476 Data-driven systems biology approach gives insight into a complex process of water remediation
J. Kronberg-Guzman, The University of Birmingham / School of Biosciences; T.D. Williams, University of Birmingham / School of Biosciences; A. Mark, Wageningen Agricultural University / Dept of Toxicology; E. Feokema, Wageningen IMARES; R. van der Oost, Wateren / Onderzoek en Advies; K. Chipman, University of Birmingham; F. Falciani, University of Liverpool / Institute of Integrative Biology

Introduction. Increasing population and industrial production put strain on clean water resources. To meet this challenge, innovation with advanced waste water treatment plants, water quality could be improved further before releasing it. Constructed wetlands have been used for water treatment for decades and are a low-cost natural option. Waterhemonica is an example of such additional treatment, consisting of a sedimentation pond, reed bed and a wetland forest. In this work, we have used three-spined stickleback living in mesocosms containing water from various stages of additional remediation from three different sites in the Netherlands. Aim. The aim of this work was to understand the effects of additional steps of water remediation. Results. We have used a data-driven systems biology approach to understand the relationship between the environment (chemical concentrations), molecular high-throughput measurements (stickleback liver gene expression), physiological parameters and more traditional measures of toxicity. We have integrated all different measurements into static similarity networks and modularised these so that in each module, genes are responding in a similar way during different stages of remediation. We see that some chemicals with high chemical risk (alidcarb, chlorpyrifos, fluoranthene, pirimiphos methyl) decrease in all sites and are also correlated with gene expression in both male and female stickleback. However, some chemicals are only correlated with gene expression in one of the male of female stickleback. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCB-s and mineral oils) are associated with modules containing several high-risk chemicals. Functional annotation reveals further insights. For example a module of the male stickleback network correlated with liver weight and several chemicals including tricosan and phthalates has a statistically significant number of genes from the KEGG pathway „metabolism of xenobiotics by cytochrome P450“ . However, a module in the male-specific network that is not correlated with any chemicals, is enriched in KEGG functions related to immune functions („antigen processing and presentation“, „type I diabetes mellitus“ and „cytokine-cytokine receptor interaction“). Conclusion. We have showed the potential of data-driven systems biology approach integrating various types of data to give insight into the effects of a complex remediation system.

477 Co-expression network analysis of massive proteogenomic data: applications in ecotoxicology.
D. De Vito, Insep; Istraa / UL RIVERLY Laboratoire Ecotoxicologie; C. ALMUNIA, CEA Paris-Saclay; D.D. Gouveia, Istraa Lyon / UR MALY Laboratoire Ecotoxicologie; J. Trapp, Istraa Lyon; J. Gaillard, CEA / Laboratoire de Biochimie des Systemes Perturbés; O. Pible, CEA; a. chaumot, O. Geffard, Istraa / UR MALY Laboratoire Ecotoxicologie; J. Armengaud, CEA / Laboratory Innovative technologies for Detection and Diagnostics Discussion mining of human and zebrafish omics data in test species under uncontaminant exposure promises the possibility to gain insights into the mode of action of chemical compounds and molecular pathways involved in toxic responses. Intuitive network concepts (e.g. connectivity and modularity) have been found useful for analyzing complex interactions and successfully applied to study gene-gene and protein-protein interactions. Currently, a majority of protein networks are constructed using protein-protein interaction (PPI) databases. However, manually curated PPI databases are typically heterogeneous, documented for few model species, and often characterized by incomplete coverage, and selection or detection biases. De novo (or no a priori) approaches based on observed data offer an alternative under which prior knowledge of protein interaction is not necessary but rather advantageously replaced by direct measurements and pair-wise correlation analysis of their abundance. This approach may be particularly powerful to identify signaling pathways which proteins with unknown function belong to or to identify novel, pertinent biomarkers of toxicant exposure. Here we present a network analysis method applied to shotgun high-throughput proteomic data we produced for the aquatic sentinel organism Gomporthax fossettii, a stickleback, proteinomics was used to identify the molecular key players involved in different physiological states linked to reproduction and in case of exposure to insecticides potentially inducing endocrine disruption in this crusteacean. We identified protein modules significantly associated to morphologically well-characterized physiological states and to pesticide exposure. Moreover, the identification of crucial hub proteins could allow proposing exposure-related or toxicological functional biomarkers. This new data mining procedure opens interesting perspectives for the development of a novel generation of molecular diagnostic biomarkers in ecotoxicology.

Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (I)

478 How researchers can work in alliance with citizens to fight misinformation and improve public debates
S. Vanhoenick, Sense About Science EU

Public resistance against glyphosate, GMOs, animal testing, vaccination and numerous other scientific innovations has made many scientists defensive and paranoid about the public. Recent discussion about a post-truth society and anti-intellectualism have increased this perception of a hostile and ignorant public. With concrete examples, Sofie will illustrate a different, more effective approach for both researchers and non-researchers to bring back reason into emotional debates. This approach, called public expert fed – in which scientists respond directly to real, unedited questions from the public – breaks through polarised and difficult debates because conversation is led by the questions and issues people raise. It allows researchers to identify gaps and misunderstandings in the public debate and to respond to them. With this approach, rather than fighting the public resistance against new technologies, researchers can work in an alliance with citizens to fight misinformation and improve the public debates.

479 Discussion: the need to promote good science and evidence in public debates

480 How to communicate the risks posed by endocrine disrupting chemicals? (I)
J. Legler, Utrecht University / Institute for Environmental Studies

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

481 How to communicate the risks posed by endocrine disrupting chemicals? (II)
M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organismal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

482 Discussion Endocrine Disrupting Chemicals

483 A regulator’s perspective in involving stakeholders and the public in the regulation of a substance
C. Ajan, ECHA-European Chemicals Agency; W. de Wolf, ECHA / Product Safety & Regulatory Compliance

The European Chemicals Agency (ECHA) was established in June 2007 through
the REACH Regulation, and the registration of all substances already on the market above 1 ton per annum will be completed in 2018. Since its start the areas of responsibility expanded from industrial chemicals to biocides, capturing as well the communication of chemical hazards to workers and the public through the Classification, Labelling and Packaging Regulation (CLP), and the regulation of international trade of hazardous chemicals. The latter includes support for the protection of human health and the environment by providing developing countries with information on how to store, transport, use and dispose of hazardous chemicals safely through the Prior Informed Consent Regulation (PIC). Un in its decision making and opinion forming, ECHA uses the scientific information provided by academia and industry and applies them within the regulatory framework that it operates. Transparency is one of the values that is driving ECHA in its interactions with its different stakeholders, and the ECHA Scientific Committees invite ECHA’s accredited stakeholders as regular observers and contributors to its meetings. 

This presentation will look at regulatory science communication by describing the different stakeholders that ECHA interacts with, the forms of communication used and their timeframes. It will also explain the regulatory boundaries ECHA has to abide to, which influence the uptake of the latest science developments, and their communication with a special focus on the decision making and opinion forming at the Member State Committee. DISCLAIMER: ‘The views expressed in this abstract are solely those of the authors and the content of the paper does not represent the views or position of the European Chemicals Agency’.

484 Questions/Discussion

485 General Discussion with panel of Sofie Vanthournout, Juliette Legler and Markus Becker

486 Concluding remarks part I and a teaser for part II:
A. Leopold, Calidis Environment BV / Calidis Environment BV; T. Seiler, RWTH Aachen University / Ecosystem Analysis; C. Ajao, ECHA-European Chemicals Agency

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (III)

487 The impact of chemical pollution on the resilience of soils under multiple stress
A. Haeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; W. Ameling, University of Bonn; H. Hollett, RWTH Aachen University / Institute for Environmental Research; M. Kaestner, Helmholtz Centre for Environmental Research UFZ / Dept Environmental Biotechnology; E. Kandel, University of Hohenheim; J. Kruse, University of Bonn; A. Miltner, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnology; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; H. Pegel, University of Hohenheim; S. Peth, University of Kassel; C. Poll, University of Hohenheim; G. Rambold, University of Bayreuth; M. Schloter, Helmholtz Zentrum Munchen / Research Unit Environmental Genomics; S. Schulz, Helmholtz Zentrum Munchen; T. Streek, University of Hohenheim; M. Roß-Nickoll, RWTH Aachen University / Institute for Environmental Research

Soils are faced with man-made chemical stress, such as the input of organic or metal-containing pesticides, in combination with non-chemical stressors like soil compaction due to agricultural traffic and natural disturbance like drought. Although multiple stress factors are typically co-occurring in the environment, research in soil sciences on this aspect is limited and focuses mostly on single structural or functional endpoints. A mechanistic understanding of the reaction of soils to multiple stressors is currently lacking. Based on a review of resilience theory, we introduce a concept for research on the ability of soil polluted by xenobiotics or other chemicals as one stressor to resist further natural or anthropogenic stress and to retain its functions and structure. There is strong indication that pollution as a primary stressor will change the system reaction of soils i.e., its resilience, stability and resistance. It can be expected that pollution affects the physiological adaption of organisms and the functional redundancy of the soil to further stress. We hypothesize that the recovery of organisms and chemical-physical properties after impact of a follow-up stressor in polluted soil differ from that in non-polluted soil, i.e., polluted soil has a different dynamical stability, and resilience of the contaminated soil is lower compared to that of not or less contaminated soil. Thus, a polluted soil might more easily change into another system regime after occurrence of further stress. We highlight this issue by compiling the literature exemplarily for the effects of Cu contamination and compaction on soil functions and structure. However, examples of further co-occurring stress scenarios will be described as well. In this discussion paper, we propose to intensify research on effects of combined stresses involving a multidisciplinary team of experts and provide suggestions for corresponding experiments. Our concept offers thus a framework for system level analysis of soils paving the way to enhance ecological theory.

488 Combined effects of temperature and metal exposure on cell membrane fatty acid composition, lipid peroxidation, antioxidant capacities and desaturase and elongase transcription - freshwater fish
M. Fadhlaoui, INRS - Eau, Terre et Environnement / Centre Eau Terre Environnement; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; P. Couture, INRS / Centre Eau Terre Environnement

In this project, two freshwater fish commonly found in areas affected by metal contamination were acclimated to different temperatures (9 and 28°C for yellow perch (Perca flavescens) and 15, 25 and 30°C for fathead minnow (Pimelnhales promelas)) and exposed either to Cd or Ni during 8 weeks. At the end of exposures, we measured cell membrane phospholipid fatty acid composition, the activities of superoxide dismutase, catalase, glutathione-S-transferase, glutathione peroxidase (enzyme indicators of antioxidant capacities), the concentrations of glutathione (antioxidant) and malondialdehyde (indicator of lipid peroxidation (LPO)) as well as the transcription levels of desaturases (fads2, desg2, scd2) and elongases (elov12, elov15, elov16). Both yellow perch and fathead minnow counteracted the effects of changes in acclimation temperature on cell membrane properties by remodelling their phospholipid fatty acid composition. Specifically, in the muscle of both species, polyunsaturated fatty acids increased in cold-acclimated fish compared to warm-acclimated fish, in agreement with the theory of homeoviscous adaptation. However, the brain cell membrane composition was more conservative, especially in fathead minnows. Polyunsaturated fatty acids are more vulnerable to LPO than saturated fatty acids and metal contamination leads to oxidative stress. We therefore tested the hypothesis that temperature-induced changes in cell membrane polyunsaturation are accompanied by variations in LPO in metal-exposed fish. Unexpectedly, in both species, metal exposure itself affected membrane fatty acid composition. In yellow perch, the normal response of cell membrane composition to thermal acclimation was reversed by exposure to both metals. Yet, in spite of the high polyunsaturation level in warm-acclimated fish under Ni exposure, MDA concentration was the lowest, suggesting a massive response of the antioxidant system to fight against LPO. In fathead minnow, metal exposure also affected the membrane fatty acid composition of both tissues, but in a way opposite than for yellow perch. We observed a mismatch between desaturase and elongase gene transcription and membrane composition. Overall, our results suggest that levels of control of cell membrane fatty acid composition other than gene transcription may be affected by temperature and metal exposure, such as post-transcriptional regulation of gene transcription and de novo phospholipid biosynthesis.

489 The effect of water chemistry on cadmium induced olfactory impairment in juvenile rainbow trout (Oncorhynchus mykiss)
S. Voiz, RWTH Aachen University / Department of Ecosystem Analysis; S. Bogart, A. Macdonald Wilson, University of Lethbridge / Department of Biological Sciences; H. Hollett, RWTH Aachen University / Institute for Environmental Research; G.G. Pyle, University of Lethbridge / Biological Sciences

Fish are dependent on olfaction since a variety of essential behaviours, such as foraging, predator avoidance and mate selection, are mediated by the olfactory system. Metals are well known to affect the olfactory system of fishes at relevant concentrations. As metal toxicity varies with water chemistry, it is essential to assess the effect of Cd on the olfactory system, fish were exposed to 45-720 µg/L Cd for 24 h. Subsequently, olfactory responses to two odorants were measured via electro-olfactography (EOG). To investigate the impact of water chemistry on cadmium-induced olfactory impairment, in order to assess the effect of Cd on the olfactory system, fish were exposed to 45-720 µg/L Cd for 24 h. Subsequently, olfactory responses to two odorants were measured via electro-olfactography (EOG). To investigate the impact of water chemistry on cadmium-induced olfactory impairment, fish were exposed to the EOG-based 24-h IC50 of Cd (210 µg/L) in reconstituted water with varying hardness, pH, and dissolved organic carbon (DOC) concentrations for 24 h. Cd inhibited the EOG response of rainbow trout in a concentration dependent manner. Fish exposed to 210 µg/L Cd for 24 h showed reduced olfactory response to TCA by 50%. Changes in water chemistry had a significant impact on Cd-induced olfactory impairment. Decreasing water hardness from 130 to 40 mg/L as CaCO3 increased the inhibitory effect of Cd on the EOG response from 55% to more than 95%, respectively. Hence, hardness ameliorated Cd induced olfactory impairment. By contrast, Cd-induced olfactory inhibition increased with rising pH, which may be due to a difference in metal speciation. DOC had a protective effect against Cd-induced olfactory impairment, likely by forming complexes with Cd ions and reducing their
bioavailability. In conclusion, water chemistry is an important modulator of metal toxicity, not only for acute lethality but also for sub-lethal effects, such as olfactory impairment. In order to enable the prediction of site-specific olfactory toxicity, the development of a BLM parametrized to the olfactory system of fish would be very beneficial. However, more data on the effect of water chemistry on metal-induced olfactory impairment is required to be able to determine affinity constants and maximal binding capacities.

490 Physiological and biochemical responses of polychaetes: interplay of elements contaminated sediments and salinity changes

A. Pires, Universidade de Aveiro / Biologia; R. Freitas, University of Aveiro / Department of Biological Sciences CESAM; C. Patinha, Universidade de Aveiro, E.F. Silva, University of Aveiro / Geosciences; E. Figueira, University of Aveiro / Biology CESAM. Coastal systems often serve as sinks for toxic elements, and changes in salinity, predicted to occur due to global climate change, are expected to influence elements geochemistry in aquatic systems. The effects of these changes can also alter biota sensitivity and end up interfering with biotoberators fitness and therefore modify their influence as ecosystem engineers. Regarding mud shrimp, only a few factors have been studied. Their fossorial life style deeply alters the physical and biochemical properties of the sediments they live in. Knowing whether stressors interferes with the olfactory system of fish would be very informative. In this study we evaluated the effect of salinity changes on a marine polychaete. Polychaetes performance, highlighting modifications that coastal systems may undergo due to alterations driven by salinity change. Polychaetes were exposed to metal contaminated sediments (median sand and fine sand sediments, collected from contaminated areas from ria de Aveiro lagoon, Portugal) and salinities 21, 28 and 40, for 28 days. This study aimed to evaluate physiological capacities of Diopatra neapolitana, behaviour (burrowing tests with Hediste diversicolor and Arenicola marina) and biochemical responses: indicators of cell damage (LPO antioxidant (SOD and CAT), and biotransformation (GSTs) enzymes. After exposure, both types of sediments had lower total elements concentration (TEC), when compared to original sediments, mainly in sediments with A. marina and H. diversicolor. Sediments exposed to salinity 40, mainly those containing H. diversicolor had even less TEC than remaining sediments, which seems that salinity changes may influence elements availability. LPO levels were higher at salinity 40 for H. diversicolor and A. marina, and at salinities 21 and 40 for D. neapolitana. Although polychaetes were able to increase the activity of SOD, CAT and GSTs, these defense mechanisms were not sufficiently effective to fight against the excess of ROS, leading to LPO. Furthermore, in H. diversicolor, the burrowing behaviour was impaired in polychaetes in fine sand sediments and salinity 40. For A. marina exposure to median sand sediment for all salinities and to fine sand for salinity 40 led to a decrease in bioturbation. Furthermore, D. neapolitana individuals at salinities 21 and 40, for both sediments, exhibited lower capacity to regenerate their body when compared to salinity 28 (control). Overall, this study demonstrates that variations in salinity can strongly affect elements availability. Interaction of both variables impacted polychaetes responses differently.

491 Do trace metal contamination and parasite infestation influence the activity of the bioturbator Upogebia pusilla?

A. da Rairon, EPOC, University of Bordeaux / UMR EPOC CNRS 5805; X. de Montaudouin, A. Clutar, P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; V. Le Bissonnais, Bandimont. Université de Bordeaux / UMR EPOC CNRS 5805; J. Le Maire, P. Gouves, G. Daffé, A. LEGEAY, University of Bordeaux / UMR EPOC CNRS 5805. In marine environment, bioturbating species are considered as important ecosystem engineer species. Bioturbators are mainly benthic organisms living in the sediment. Their fossorial life style deeply alters the physical and biochemical properties of sediments. In marine soft-bottom environments, mud shrimp are considered as among the most important bioturbators. Because of their intense burrowing activities, they exert a major influence on the salinity exchange, nutrient transformation and benthic community composition. The influence of mud shrimp on their environment is related to the intensity of their behavior. Several factors could influence with bioturbators fitness and therefore modify their influence in the ecosystem engineer species. Regarding mud shrimp, only a few factors have been studied. Among them, the role of trace metals on mud shrimp fitness and bioturbation activities has never been investigated yet. Besides, mud shrimp are frequently parasitized by bopyrid isopods, known to have a deleterious effect on their host. Indeed, they deeply impair mud shrimp physiological state and potentially alter their bioturbation intensity. The aim of this study was to examine the role of a common trace metal (cadmium) and of bopyrid parasites on the physiology and the bioturbation activity of the mud shrimp Upogebia pusilla. We performed a 14-days ex-situ experiment evaluating the influence of Cd and/or parasite on the mud shrimp U. pusilla. Cadmium bioaccumulation and potential genetic responses to stress exposure were determined after 3, 7 and 14 days to trace metal exposition. The influence of both stressors on U. pusilla bioturbation activity was determined by evaluating sediment reworking rates of the mud shrimp after 3, 7 and 14 days to trace metal exposure.

492 Integrating ecotoxicology and ecology to advance understanding and prediction in multiple stressor research

R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences; J. Piggott, Trinity College Dublin / Zoology. Global environmental change is driven by multiple anthropogenic stressors. Conservation and restoration requires understanding the individual and joint action of these stressors to evaluate loss of ecosystem services. To date, most studies on multiple stressor effects have sought to identify potential stressor interactions, defined as deviations from null models, and related meta-analyses have focused on quantifying the relative proportion of stressor interactions across studies. These studies have provided valuable insights about the complexity of multiple stressor effects, but remain largely devoid of a theoretical framework for prediction of effects and null model selection. We suggest that multiple stressor research would benefit by 1) integrating additional null models from ecotoxicology and 2) selecting null models based on their mechanistic assumptions of the stressor mode of action and organism sensitivities as well as stressor-effect relationships. We present a range of null models and outline their underlying assumptions and applications on multiple stressor interactions. Moving beyond mere description requires multiple stressor research to shift its focus from identifying statistically significant interactions to the use and development of mechanistic (null) models. We discuss how ecotoxicological and ecological concepts will aid in achieving this.

Improving the Quality of Ecotoxicological Testing and Assessment

493 Updating the OECD Guidance Document 23 on aquatic toxicity testing of difficult substances and mixtures to include state-of-the-science approaches

W.S. Hunter, U.S. Food and Drug Administration / Center for Veterinary Medicine; G. Stoddart, C. Fatbinder, PETA International Science Consortium Ltd.; M. Balder, European Commission Joint Research Centre / DG Joint Research Centre IHCP EURL ECVAM; E. Salinas, BASF SE / Eperimental Toxicology and Ecology. The Organisation for Economic Cooperation and Development (OECD) Guidance Document (GD) on Aquatic Toxicity Testing of Difficult Substances and Mixtures (GD 23) was first published in 2000 and provides crucial guidance that supplements OECD Test Guidelines. Since its release much experience has been gained in handling difficult-to-test chemicals in aquatic exposures as well as progress made in developing methods for testing difficult test chemicals. The GD was revised as recently as 2016 to include state-of-the-science approaches. We provide an overview of the updated GD 23. One significant revision was the expansion of the guidance on testing of poorly water soluble test chemicals. Attention was paid to updating exposure methods that do not employ a solvent in order to eliminate the need for a solvent control, and thus, reducing the number of animals used in aquatic toxicity tests. Another major revision was the addition of more detailed guidance for substances of unknown or variable composition, complex reaction products, and biological materials (UVCBs). The presentation also briefly describes other aspects of the updated GD of interest to those involved in aquatic toxicity testing. The updated GD 23 will help government agencies, industry, and contract research organisations conduct valid and reliable aquatic toxicity studies on difficult-to-test chemicals while minimising both the number of animals used and the need to repeat studies. The views, conclusions and recommendations presented in this presentation are those of the authors and do not necessarily represent the policies or positions of the United States Food and Drug Administration, the PETA International Science Consortium Ltd., the International Council on Animal Protection in OECD programmes, the European Commission or the OECD.

494 Calibrating Non-Target Arthropod (NTA) Lower Tier Assessment Factors

F.M. Bakker, Eurofins-Mitos; S. Aldershof, Bioresearch and Evaluation; A. Dinter, Cheminova Deutschland GmbH & Co. KG / Global Regulatory Sciences; C. Eslon, Syngenta Ltd; C. Mayer, BASF SE / Ecotoxicology; E. Pilling, Dow Agrisciences / Regulatory Sciences; G. Weyman, ADAMA; P. Neumann, Bayer AG. Assessment factors for the non-target arthropod (NTA) studies were calibrated against NTA full fauna field studies for a large array of species, 20 active ingredients (23 products) and wide geographic coverage in the EU. It was investigated whether the current assessment endpoints at lower testing tiers are sufficiently protective and whether the array of test systems is sufficiently comprehensive. Lower tier studies, both Tier 1 and Tier 2, with several test species informative for calibrating limit values for assessment factors based on different field risk tolerance criteria, for example in-field recovery periods varying from 1 to 12 months. Phytophagous taxa were analysed separately, but as no differences in

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outcome with other taxa were observed, these were considered jointly. As expected Tier 1 studies had the most sensitive endpoint and consequently the largest HQ. Using the recovery endpoint, it was found that for the off-field HQ’s of 1, 6 and 250 delayed recovery ranges of 0 weeks (no effects), 4 weeks and 8 weeks, respectively in the off-field situation (hay meadow paradigm). For the in-field situation recovery intervals of 0-1, 1-2, 6-12 and 12+ months were delimited by HQ values of 40, 375, 620 and 2590 respectively. Tier 2 studies could have lethal effects for sublethal endpoints. Using the most sensitive of the two and including a Vegetation Distribution Factor (VDF) of 5 the following HQ-values were derived for the off-field: HQ=1.7 for a no effect level. These HQ’s also correspond to 1 and 2 month recovery periods. For the in-field, using VDF=1, HQ’s are 1.3 for no effect and 6.6, 15, 60 and 560 for 1, 2, 6 and 12 months respectively.

495 The unforeseen consequences for animal welfare of the OECD TG 240 (MEOGRT) biological validity criteria E. Salinas, MASB SE / Experimental Toxicology and Ecology; L. Welter, MASB SE / Crop Protection Ecotoxicology

The Medaka Extended One Generation Reproduction Test (MEOGRT) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The MEOGRT brings together all aspects of the OECD chronic fish TGs 210, 234, and 229 into one test. OECD TGs include validity criteria as minimum standards for acceptable performance and particularly the biological control performance criteria are critical to assure relevant effects of a test chemical are detectable. Variability criteria assist regulators in determining study quality and reliability; studies that do not comply may be rejected and/or repeated. Compared to other fish TGs, the quantity of validity criteria in the MEOGRT TG have increased and are more stringent, thus elevating the potential for failure and repetition. Other investigators have already noted a high incidence of study repetition following well established OECD fish TGs. However, available data is as scarce as the OECD TGs and currently very few laboratories can implement this highly complex TG. The MEOGRT arose from an international validation effort and recently the data from 9 validation studies were published. We compared control performance in those studies against the existing MEOGRT validity criteria to evaluate the compliance rate. Only 3 studies reported the control parameters corresponding to all biological control criteria and only 1 out of the 9 studies demonstrated successful compliance. The most prevalent deviation from the validity criteria was in the fecundity performance (4 out of 9 studies). Although some deviations from the validity criteria were minor, the failure to meet the fecundity criterion cannot be dismissed in a reproduction test where high fecundity is directly related to statistical power. The MEOGRT feminized control validation is in principle achievable; however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a MEOGRT. The biology of the medaka has advantages, but also poses large hurdles to achieving reliable and valid test results. Therefore, alternative species and/or study designs should be considered to generate the data required to address protection goals, which also reduce the potential for excessive animal use.

496 Variability in Non-Target Terrestrial Plant Studies Should Inform Endpoint Selection J.W. Green, DuPont / Data Science and Informatics; J. Nuz, Exponent, Inc.; D.E. Edwards, BASF Corporation / Ecotoxicology; K. Henry, NovaSource / Tesserlendt Kerley, Inc. / Ecological Sciences; M.E. Kern, Waterborne Environmental, Inc. / Ecotoxicology Risk Assessment; A. Deines, Exponent; R. Brain, Syngenta Crop Protection, Inc. / Department of Environmental Risk Characterization; B. Glenn, Bayer CropScience / graduate student; N. Ehresman, Nifarm; T.S. Kung, FMC Corporation / Global Regulatory Sciences / Global Regulatory Sciences, Department of Biochemistry and Microbiology; F. Kee, FMC Corporation; K. Ralston-Hooper, Dow Agrosciences; S. McMaster, Industry Task Force II on 2,4-D Research Data Inherent variability in Non-Target Terrestrial Plant (NTPP) guideline testing of pesticide validations challenges is in principle achievable; however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a MEOGRT. The biology of the medaka has advantages, but also poses large hurdles to achieving reliable and valid test results. Therefore, alternative species and/or study designs should be considered to generate the data required to address protection goals, which also reduce the potential for excessive animal use.

497 An avian reproduction study historical control database: A tool for data interpretation J. Wheeler, Dow AgroSciences; P. Valverde-Garcia, Dow Agro Sciences LLC; T.A. Snelgrove, EAG Laboratories / Specialist Projects & Histology; V.J. Kramer, Dow AgroSciences LLC / Ecotoxicology; M. Foudoulakis, Dow Agrosciences / RSRA; I. Barber, Dow AgroSciences

Avian reproduction studies are a regulatory requirement for pesticides in many regions. The data often require careful interpretation due to the nature of the study design; here we present a database of literature studies on mallard duck reproduction studies performed at the Evans Analytical Group LLC avian toxicology laboratory over the period 1985 - 2016. The analysis demonstrates the stability of reproductive parameters over time and good agreement to normal control ranges as required by the regulatory test guidelines. The major source of variation is shown to be within study variation. Recommendations for the use of historical control data for the interpretation of avian reproduction studies are made. We believe the analysis and evaluation presented here can facilitate the development of practical guidance that can be implemented in regulatory programmes requiring this test.

498 Experimental Design and Model Selection for Ecotox Risk Assessment J.W. Green, DuPont / Data Science and Informatics

Recent experience with regulatory requests for re-analysis of older studies using newer statistical methodology has resurrected an old statistical issue of designing a study to fit its objectives and the dangers of imposing a statistical structure on data not fit for purpose. There is a continual need to update statistical methodology as new ideas arise and data is aware to implement these methods become available. Problems can arise when new methods are imposed on old experimental designs. Imagine buying a plot of land with a small cottage. If we tear down the cottage, but leave the cellar and foundation, and then build a mansion in its place but based on the existing foundation, the resulting structure can be unstable and severely restricted in functionality. This presentation will explore the relationship between experimental design and the type of statistical model that can be fit to the resulting data and endpoints that can be estimated or determined from the model. In some instances, newer methods can be applied without problem to existing data. In other cases, existing data cannot support newer methods. It is important to understand the data requirements of the methods or models we intend to use. The size effect that can be estimated or detected is critically important and is strongly related to experimental design and biological variability. There is a model underlying every statistical test used to derive a NOEC or estimate an ECx. The basic statistical model for a simple toxicity experiment is given by Y=µ+ε, where µ is the expected mean response in the i^{th} concentration, and the ε are independent random errors, usually assumed to be identically distributed. What distinguishes one model from another is what distribution is assumed for the errors or responses and what restrictions or assumptions are placed on the treatment means, µ. It is possible to determine the size effect that can be estimated or detected from a given dataset and it depends largely on experimental design and response variability. Statistical models used for hypothesis testing or regression estimates have data requirements. Model assessment tools are well established and should be used in fitting models to ecotoxicity data. Ignoring these tools or model requirements can lead to poorly estimated effects and misleading results. Understanding these concepts enables the scientist to make sound assessments of the data collected.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (II)

499 Integration of Risk Assessment and Life Cycle Assessment in the context of recycling wood waste into particleboard S. Haywood, R.A. Alvarenga, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology

Recycling of wood waste into particleboard has some environmental advantages, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, therefore, recycling of post-consumer wood waste requires special attention to the determination and control of contaminants. For instance, in the particleboard industry, heavy metals may be present in demolition wood waste, for instance, by giving second life to wood waste, and then build a mansion in its place but based on the existing foundation, the resulting structure can be unstable and severely restricted in functionality. This presentation will explore the relationship between experimental design and the type of statistical model that can be fit to the resulting data and endpoints that can be estimated or determined from the model. In some instances, newer methods can be applied without problem to existing data. In other cases, existing data cannot support newer methods. It is important to understand the data requirements of the methods or models we intend to use. The size effect that can be estimated or detected is critically important and is strongly related to experimental design and biological variability. There is a model underlying every statistical test used to derive a NOEC or estimate an ECx. The basic statistical model for a simple toxicity experiment is given by Y=µ+ε, where µ is the expected mean response in the i^{th} concentration, and the ε are independent random errors, usually assumed to be identically distributed. What distinguishes one model from another is what distribution is assumed for the errors or responses and what restrictions or assumptions are placed on the treatment means, µ. It is possible to determine the size effect that can be estimated or detected from a given dataset and it depends largely on experimental design and response variability. Statistical models used for hypothesis testing or regression estimates have data requirements. Model assessment tools are well established and should be used in fitting models to ecotoxicity data. Ignoring these tools or model requirements can lead to poorly estimated effects and misleading results. Understanding these concepts enables the scientist to make sound assessments of the data collected.
into particleboard. A need exists to investigate the local human health risks associated with recycling contaminated wood waste, while simultaneously considering other impacts on human health and the environment throughout the entire life cycle traditionally modelled with Life Cycle Assessment (LCA). The objective of this study was the combined use of local Risk Assessment (RA) and LCA to achieve a broader assessment of the sustainability of recycling contaminated wood waste into particleboard. The current scenario, in which the use of contaminated wood waste in particleboard is limited by Flemish government’s standards, is compared to a future scenario with a higher use of more contaminated wood waste. As a consequence, in the future scenario, a lower proportion of the contaminated wood waste will be incinerated with electricity (and heat) recovery. Modeling of the local air pollution will be performed with the Impression Prognosis Air Concentration Tool (IMPACT) of the Flemish government. The LCA scope includes the particleboard industry, relevant upstream and downstream processes of the particleboard industry, and the incineration of wood waste. To integrate RA and LCA results on human health effects the concept of disability-adjusted life years (DALYs) is adequate as a common metric. Results will be presented at the conference.

500 Development of non-conventional LCA indicators for circular characteristics of bio-based products
K. Lokesh, University of York / Department of Chemistry; X. Bengoa, Quantis; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; A. Erents, EMPA / Technology and Society Lab; R. Hischier, EMPA / Technology and Society Lab; F. Piccinno, EMPA Technology & Society Lab; R. Hischier, EMPA / Technology and Society Lab; F. Piccinno, EMPA
This work is dedicated to the identification of key “un-conventional” indicators that demonstrate the sustainability and circular characteristics of promising bio-based products, complementing conventional life cycle analysis. Some of the new LCA complementary indicators proposed as a part of this study emphasise on resource efficiency and material circularity of bio-based value chain and include (but are not restricted to) waste circularity, critical material circularity, land-use efficiency and output quality services. The proposed indicators were drawn out of a comprehensive evaluation of more than 45 certification labels, schemes and initiatives associated to bio-based products, relevant international and national standards and 80+ scientific articles encompassing bio-product life cycle assessment. A current need for a harmonised sustainability certification protocol, coupled with an aim to develop an indicator-led assessment framework lead to the identification of potential gaps in criteria and indicators. Adoption of bio-based products has been identified as the one of the pathways to reach a sustainable economy. Some of the many advantages conceived from adopting bio-based value chains include development of waste-management infrastructure, job creation, SME’s and other environmental opportunities, contributing directly to seven out of 17 UN Sustainable Development Goals. The benefits of such systems approach can be realised only via quantitative and qualitative evaluation of the embedded environmental, techno-economic and societal impacts, all of which are a function of a product’s variables like feedstock type, technology-route, product’s functionality and application [1]. Life cycle assessment, a robust impact-led sustainability assessment tool, that can help to manage these impacts via a holistic approach has insufficiencies, mainly the limitations in addressing the circular product characteristics. This work is a part of the EU-H2020 funded project, Sustainable Transition Assessment and Research of Bio-based products, the ultimate aim of which is to expand existing tools and methodologies for sustainability certification of bio-based products and for their speedy commercial uptake.

501 Toward a more sustainable biochemical industry - Early stage assessments and methodological overlaps between life cycle- and techno-economic assessments of biochemicals
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Existing Life cycle assessment (LCA) studies of biochemicals reveal that there are challenges that need to be overcome in order to reach an overall high sustainability performance. While in some cases biochemicals have lower global warming impacts compared to fossil-based chemicals, other impacts may become higher, like eutrophication. One of the major sources of environmental impacts of biochemicals is the growing of biomass, which in most cases today is corn. This has led to investment in assessing opportunities of using side streams, like leftover agricultural lignocellulose, or even algae-based biomass like algae. Macro-algae is one such potential source that given they grow without being farmed, while simultaneously being an important sink for CO2. The objective of this study is to identify trade-offs between assessed environmental impacts and possible burden shifting between macro-algae compared to more conventional feedstocks like maize and lignocellulose. While it is imperative that any change in process configuration reflects in Techno-Economic assessment (TEA) and LCA, there are very few studies which couples these two assessment demonstrating the trade-offs for improved decision support. The focus of this contribution is to explore methodological overlap between the two assessments and develop a framework, supported by a proof-of-concept. When contrasting current results from the TEA and LCA cradle-to-gate study, some interesting trends were observed. The TEA show that idos biggest hotspots are identified as feedstock cost which is a function of growing, transportation of biomass and if drying is taking place at the refinery site or closer to the harvesting sites of the feedstock. Whereas, the LCA shows the biggest environmental hot-spots occur in relations to growing of biochemicals and requires external application of nutrients and intensity of chemical pretreatment. Today decisions on new chemicals are further developed companies more rely of results from TEAs. Our results show that the methodological overlap between TEA and LCA are of that magnitude that justifies the appraisal of this integrated methodology. Introducing LCA as a decision support tool would integrate sustainability requirements in development of technology and solutions. All technologies and products have a life cycle, and by analyzing their impacts, we put numbers on sustainability and benchmark the solutions.

502 A risk evaluation approach for indirect land use change associated to biobased products
D. Marazza, University of Bologna; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; V. Rossi, Quantis; J. Golazewski, UniversyterwarsinskiMazurski W Olzynie
Biobased products include a vast range of traditional and innovative materials and substances for purposes other than food and energy such as wood and composite materials, bio-plastics, adhesives, lubricants, paints and many other material categories feeding large economic activities. There is international recognition that developing a climate-smart bio-based economy is essential to the continuation of economic development, reduction of greenhouse gas emissions, and adaptation to climatic change. However, as biobased products are ultimately obtained from land or sea, a specific attention has to be payed when considering additional exploitation. Changes of land/sea uses can rebound and cancel out environmental performances and environmental risk needed for the decision making process. Indirect land use change (ILUC) has been defined as an unintentional, negative, displacement effect of commodities in the primary sector such as agriculture causing additional land use changes. Provided that ILUC depends on specific legacy effects stemming from land condition prior and after land use changes, overall indirect effects are connected to the 1.1 billion tons of greenhouse gases generated because of land use changes. However the application of ILUC provisions as for biofuels has been and stays controversial. The Project STAR-ProBio is a multi-actor collaborative research and innovation action and supports the European Commission in the full implementation of European policy initiatives, including the Lead Market Initiative in bio-based products, the industrial policy and the European Bio-economy Strategy. One of the specific goals calls for identifying and mitigating the risks of negative ILUC effects associated to production routes for bio-based products. In this contribution the authors present the conceptual model and the results of the identification of risk factors obtained from the analysis of economic models and a sensitivity analysis performed over one selected case study.

503 How to find sustainable applications for new materials and how to overcome the relativity of LCA
C. Sem, EMPA Technology & Society Lab; R. Hischier, EMPA / Technology and Society Lab; F. Piccinno, EMPA
The Multi-Perspective Material Selection (MPAS) method has been developed as a decision support tool to help in the selection of sustainable application fields for new materials that are still under development. This selection includes a 3-step method considering technical, economic as well as environmental criteria. So far, the method was best used for new materials that are replacing existing materials in a given application. But applying the MPAS in the case of a completely new kind of material or application field with no clear and existing competitor for comparison, the method revealed its limitations. Especially, the environmental assessment, that uses simplified LCA studies, is a relative approach. Another difficulty for the simplified LCA studies is when the production data of the material and, at the same time, the knowledge about the properties of the end-product are unknown and highly speculative. This is a common problem since the MPAS method is intended to evaluate new material or application fields at stage. Here, we present an expanded and further developed MPAS method that mitigates exactly these limitations meaning that the environmental assessment can be performed without a comparison case and also without the necessity of a lot of data. The development and expansions of the MPAS method are applied to each of its three steps. However, the main development of the method is made to Step 3, the environmental evaluation of the material. Our solution here uses a highly flexible set of criteria that are specifically adapted to the various cases and that are mainly LCA based. This means that the environmental score can now be obtained regardless of the ability to estimate the production data of the material and of the knowledge about the exact properties of the end-product. This evaluation can be applied absolutely or relatively/comparatively. Furthermore, the criteria are expanded with other criteria that go beyond only LCA relevant aspects and also include aspects like circular economy. The method is illustrated with a case study on nanoporous carbonaceous material. As a result, the most sustainable applications for this nanoporous carbonaceous material are identified and used to set parameters to be achieved for
the developers of the material. The new independent environmental assessment part in Step 3 overcomes the necessity of a comparison case while also reducing of the required amount of LCA data. This makes the method universally applicable.

**504**  
Consumption and consumer footprint: LCA as pivotal methodology for assessing consumption patterns and ecoinnovations  
S. Sala, A. Cerutti, European Commission Joint Research Centre / Bioeconomy unit; V. Castellani, EC-JRC; M. Secchi, European Commission Joint Research Centre / Bioeconomy unit

The European Commission has been developing an assessment framework to monitor the evolution of environmental impacts associated to the EU consumption. The assessment framework aims at supporting a wide area of policies, such as those related to bioeconomy, resource efficiency, ecoinnovation and circular economy. The assessment framework is composed of two sets of consumption-based indicators: the Consumption footprint and the Consumer footprint. The Consumption footprint assesses the potential environmental impact of apparent consumption, focusing on the territorial scale and accounting for trade, assigning the impact to the country where the final consumer is located. The Consumer footprint assesses the potential environmental impact of consumption, based on the results of life cycle assessment (LCA) of representative products purchased and used in one year by an EU citizen. The Consumer footprint allow assessing environmental impacts along the products life cycle (raw material extraction, production, use phase, re-use/re-cycling and disposal). For the calculation of the Consumer footprint, the consumption of European citizens is split into five key areas (food, housing, mobility, household goods and electric/electronic appliances). For each area, a respective Basket of representative Products (BoP) has been built based on statistics on consumption and stock of product. For each of the five BoPs, a baseline scenario is defined, taking as reference the consumption of an average EU citizen in the baseline year 2010. For the BoPs, environmentally relevant variables have been selected in order of assessing the environmental impact and in order of giving information for identifying the environmental hotspots along the product lifecycle and within the consumption area of each specific BoP. The results of the hotspot analysis are then used as a basis for the selection of actions towards environmental burden reduction, covering either consumption pattern, behavioral changes, implementation of eco-solutions, or a combination of the previous. For each of the actions, a scenario has been developed, acting on the baseline model and simulating the changes associated to the specific intervention. The LCA results of each scenario are then compared to the results of the baseline, to identify potential benefits or impacts coming from the implementation of the solution tested, as well as to unveil possible trade-offs.

**Environmental Risk Assessment in Sediments**

**505**  
Assessment of risk from historic contaminants in sediments of the Elbe flood plain, using a multiple line of evidence approach  
S. Heise, Hamburg University of Applied Sciences / Life Sciences; U. Rieth, Institut für Hygiene und Umwelt

The Elbe river has one of the largest catchment areas in Europe (150 000 km²) of which two thirds lie in Germany. While it was once considered to be among the most polluted rivers in Europe, water quality has largely improved since the fall of the Iron Curtain in 1989. Sediments, however, still carry the memory of an industrial past and are often “on the move”, transported by the current and especially during flood events to downstream sites. The question, where they originate, what chemicals they carry and how much of it may still be around, has been in the focus of several previous studies (e.g. Heise et al. 2008; Hillebrand et al. 2015). Little attention, however, had been paid to the long term to sediments in those ca. 1000 backwaters and flood plain lakes along the Elbe with regard to their contamination, their ecotoxicity and their mobility in times of high water discharges and flood plain submergence. Two studies, carried out in 2013 and 2014, were dedicated to this kind of structures with the task of evaluating a potential risk from these sites. Over a stretch of 230 km along the Middle Elbe, sediments from 25 backwaters were sampled, analyzed for heavy metals and for Elbe-typical historic contaminants (HCH, HCB, PCB, PAHs, DDX). Additional lines of evidence in an assessment of risk comprised the thickness of the sediment layer and sediment mobility during flood events. Dating of sediment cores by 13C analyses facilitated interpretation of the results. Samples were ecotoxicologically tested for inhibitory effects in the bacterial sediment contact test (Arthrobacter globiformis), the luminescence bacteria test (Allivibrio fischeri) with elutriates and methanol extracts and the algae growth inhibition test (Raphidocelis subcapitata) with elutriates. The studies showed that - more than 75% of all sampled sites were contaminated with heavy metals and organics well beyond the threshold values of the Elbe River Commission. - ecotoxicological effects provided a distinct line of evidence and could not be simply related to analyzed contaminant concentrations. - when integrating chemical, ecotoxicological and erosion stability data into a weight of evidence approach, high risks could be identified for 50 % of the sampled sites in 2013. - dating of sediment cores from 2014 pointed towards a strong impact of the 4 extreme flood events between 2002 and 2013 on the erosion of highly contaminated sediments from backwaters into the Elbe river.

**506**  
Multiple lines of evidence for risk assessment of old sea deposits for ilmenite mine tailings in SW Norway  

Although this mine disposes up to 3 mill. tons of tailings contaminated with trace amounts of Ni and Cu sulfides. During 1960-94 the tailings were placed in two sea deposits, first in a sheltered fjord and then in a more exposed basin. After 1994 the tailings have been placed in a land-deposit. To protect the downstream watershed area, some of the metal contaminated drainage water is recycled, mixed with other discharge and fed into the water column at the site of the fjord deposit. In 2015 the deposit and reference sites were sampled for studies of macrobenthic communities, biogeochemical fluxes, metal mobilization and metal uptake in gastropods and DGT probes. O2 and pH in the sediments were measured using micro-electrodes. The tailings were easily traced in the sediments by high concentrations of fine fractions, Fe, Ni, Cu and Co. Tailings were still abundant in the top 0-1 cm of the sediments at both deposit sites, but clearly less abundant at the sediment surface than in deep deposit layers and also less in the outer basin deposit than in the fjord deposit. Compared to Norwegian and European quality standards [1], Cu exceeded MAC-EQS ("Maximum Admissible Concentration") for coastal sediments indicating a "risk of acute toxic effect" on marine organisms. The DGT-profiles showed that Fe and Mn was recycled within the sediments, whereas Ni and Cu leaked to the overlying water from mobilization centers consistently located in the outer basin deposit. 

**507**  
In situ metal fluxes for the assessment of metal bioavailability in sediments  
E.D. Amato, University of Antwerp / Department of Biology; S.L. Simpson, Centre for Marine and Water Research / Environment Australia; A.D. Jolley, University of Wollongong / School of Chemistry; C.P. Marasinghe Wadige, University of Canberra / Institute for Applied Ecology; W.A. Maher, University of Canberra / Institute of Applied Ecology; A. Taylor, University of Canberra / Ecochemistry Laboratory, Institute for Applied Ecology

Analysis of pore waters, dilute-acid extractable metal (AEM), acid volatile sulfide (AVS), and organic carbon (OC) concentrations are frequently used to evaluate and predict metal bioavailability in sediments. Where concentrations of bioavailable contaminants are determined to exceed sediment quality guideline levels, bioassays are usually performed to evaluate toxicity effects resulting from contaminant exposure. Although the chemical analyses used for bioavailability assessment have been shown to be useful for predicting metal toxicity in sediments, the predictions for soil or sediments contaminated with a broad range of factors influencing metal bioavailability including variability in phases that are easily oxidized or reduced (e.g. AVS and Fe(II)). In addition, laboratory-based bioassays may provide inadequate predictions of metal bioavailability and toxicity due to their inability to adequately replicate field exposure conditions. A comprehensive series of studies combining laboratory and field experiments were carried out to evaluate the performance of the diffusive gradients in thin films (DGT) technique for predicting metal bioavailability in sediments. The DGT device uses an ion-exchange resin (Chelox) which selectively accumulates divalent metal present in the sediment porewater and weakly-bound to the sediment particulate phase. The DGT metal flux measured at the sediment water interface (SWI) was compared to biological responses of organisms exposed to sediments contaminated with mixtures of metals, in the laboratory (amphipods and bivalves) and in the field (bivalves). To assist in the analysis of effects from the mixtures of the metals (Cd, Cu, Ni, Pb, Zn), DGT metal fluxes were normalised using water quality guideline values to account for predicted differences in the toxicity of the different metals. Strong dose-response relationships were found between the normalised DGT metal fluxes and the predicted toxicity, including adverse effects to reproduction and survival of the amphipod exposed to laboratory conditions. Useful predictions of bioaccumulation were obtained for both marine and freshwater bivalves in laboratory and field set-ups. Differences in bioaccumulation between organisms exposed to identical sediments in laboratory and field set-ups highlighted the importance of including in sediment quality assessments lines of evidence based on in situ evaluations of metal bioavailability.

**508**  
An Overview of the Refinements and Improvements to the USEPA’s Sediment footprint
Toxicity Methods for Freshwater Sediment

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Sediment toxicity tests are used for contaminated sediments, chemical registration, and water quality criteria evaluations and can be a core component of ecological risk assessment at contaminated sediment sites. Standard methods for conducting sediment toxicity tests have been established by USEPA, ASTM, Environment Canada and OECD. Revisions to USEPA’s Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates is planned for 2018. USEPA’s manual describes toxicity and bioaccumulation testing procedures for 3 freshwater species, *Hyalella azteca* (amphipod), *Chironomus dilutus* (midge) and *Lumbriculus variegatus* (oligochaete) and 5 sediment toxicity test methods: 10-d tests with *H. azteca* and *C. dilutus*; a 42-d life-cycle test with *H. azteca*; a 50-d life-cycle test with *C. dilutus* and a 28-d bioaccumulation test with *L. variegatus*. While laboratories routinely met test acceptability criteria (TAC) for short-term sediment toxicity exposures (10-d control survival and ash-free dry weight); laboratories reported variable biological performance with the longer exposures. With input from both midge and amphipod workshops, each test method has updated guidance for the starting size/age of organisms, diets and rations, reconstituted water changes, modifications to the test acceptability control survival, weight and other endpoints. Control waters need to have a minimum level of chloride and species of a different taxonomic group, such as the midge *Chironomus riparius* or the amphipod *Hyalella azteca*, are proposed as Tier-1 test organisms for fungicides with a biocidal mode-of-action. To investigate i) the potential difference between the use of field-collected and artificial sediments and ii) whether the proposed Tier-1 approach is protective, 28-d tests with fluoroxysonil-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa individal tests for each species and method, laboratories would report their averages for the test endpoints/measures. These proficiency criteria would not be used to accept or reject individuals, but serve as a broad indicator of laboratory performance and possibly provide insight where refinements are needed. In this talk, we will focus on the testing methods and improvements that have been made in each method for USEPA and ASTM methods. This abstract does not necessarily reflect the views or the policies of the USEPA.

509 Sediment-spiked toxicity tests with benthic macro-invertebrates and the fungicide fluoroxysonil

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In the EFSA scientific opinion on sediments, one of the oligochaete worms *Lumbriculus spp.* or *Tubifex tubifex*, supplemented with a second standard test species, *Hyalella azteca* or *Chironomus riparius* or the amphipod *Hyalella azteca*, are proposed as Tier-1 test organisms for fungicides with a biocidal mode-of-action. To investigate i) the potential difference between the use of field-collected and artificial sediments and ii) whether the proposed Tier-1 approach is protective, 28-d tests with fluoroxysonil-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa individual tests for each species and method, laboratories would report their averages for the test endpoints/measures. These proficiency criteria would not be used to accept or reject individual tests, but serve as a broad indicator of laboratory performance and possibly provide insight where refinements are needed. In this talk, we will focus on the testing methods and improvements that have been made in each method for USEPA and ASTM methods. This abstract does not necessarily reflect the views or the policies of the USEPA.

510 Spatio-temporal exposure of Plant Protection Products in OECD 219 sediment test systems - Comparison of model results with measurements

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Sediment toxicity testing among other ecotoxicological tests is currently revised under the premise to improve quality and consistency of regulatory environmental risk assessment. In 2015, the European Food Safety Authority (EFSA) has published a scientific opinion on sediment toxicity testing methods and organisms where a water-spiked test system (OECD 219) is considered to study chronic effects on sediment organisms. Prominent test organisms are Chironomids, aquatic insects which live in and on soft sediments. Due to the design of this study initially large gradients between the exposure in the overlying water and in the sediment layer are established. As a consequence, substantial temporal and spatial dynamics of local concentrations have to be expected, especially in the vicinity of the interface between water and sediment where the Chironomids are supposed to stay. To describe local concentrations in such water-sediment test systems we simulated the transport and the redistribution of two moderately mobile (KOC 200 to 300) plant protection products with the mechanistic model TOXSWA. The results of the simulation are compared with measured sediment concentrations in three depths (see contribution submitted by Dorn et al.). The compound properties were parameterised using values derived independently in standard tests (KOC, DT50 water/soil) or from literature (diffusion coefficients). Other parameters were derived from OECD 219 experimental design information. The simulations matched the measured concentrations spatially and temporally well. The simulated concentration depth profiles averaged for the layers which were measured lay almost always within the range of single measurements. Also the concentrations in the overlying water were reproduced well. The main findings are that the concentrations in the sediment show a pronounced temporal pattern and that the concentrations in the sediment are strongly depth-dependent. The dominant transport process in the sediment is obviously diffusion which however did not lead to homogeneous penetration of the sediment. Presuming that chironomids live in the upper three millimetres of the sediment, they are exposed to approximately four times higher test compound concentration (total and liquid) than the average concentration in the sediment. This has important consequences for the derivation of effect endpoints of chironomids from OECD 219 study data, which should consider the local exposure of the organisms.

Wastewater effluents: How research can improve risk assessment and regulation

511 Effects of untreated wastewater dilution in surface waters on pharmaceuticals natural attenuation and on the community genomics: Implications for ERA

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The decreasing consumption and production of active pharmaceutical ingredients (APIs) in low and low-middle income countries (LMMICs) is of growing environmental concern owing to their possible ecotoxicological effects. This is related to the practice of direct discharge of untreated wastewater (DWW), which creates a heavily polluted area, named the “impact zone”. Little is known about the environmental fate of APIs in this area. Nevertheless, a few available measured environmental concentrations (MECs) of LLMICs show higher concentrations than for high-income countries with developed wastewater treatment infrastructures. Globally, the MECs of APIs in the “impact zone” are typically above 0.01 µg L⁻¹, which, if predicted, would trigger the environmental fate refinement of the environmental risk assessment (ERA). In the ERA PEC calculation, a default dilution factor (DF) of 10 is used, but in at least 53 countries worldwide, the local predicted median DF is lower than 10. There is no information available in the literature about the effects of low dilutions on the natural attenuation of APIs nor impacts of DWW. Furthermore, information on the effects of low dilution on mixtures of APIs is missing, hence necessitating the requirement for evaluation of biological endpoints for the impact zone ERA. This information is pivotal for the development of an impact zone ERA approach, and we are proposing an original approach to expand this area of research within the ERA. The new approach consists of a set of APIs studied in batch tests at several levels of dilution. Nevirapine shows persistence across the experimental period and only the dilution is controlling the observed concentrations. Acebutolol and Diclofenac show a decrease in concentration of up to 90% as a result of a combination of dilution and biodegradation. The biodegradation at no dilution shows a behaviour consistent with that previously reported study. As a consequence, the NC勿 assumption that the ecotrope alone is responsible for the 70% of the removal. The TOC analyses do not show significant consumption rate changes caused by dilution. The results regarding the effects of the APIs mixture and the dilution on the microbial composition are been analysed through bioinformatic statistics, and will be presented if significant.

512 Active Pharmaceutical Ingredients Entering the Aquatic Environment From
Impact of a wastewater treatment plant upgrade on amphipods and other macroinvertebrates: individual and community responses

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Conventional wastewater treatment plants (WWTPs) equipped with secondary and tertiary treatment steps do not or only partially remove micropollutants which makes them important point sources for the release of these substances in the water cycle. Micropollutants can cause short- or long-term adverse effects in aquatic organisms even at low concentration levels. One possibility to reduce the input of micropollutants into the water cycle is the upgrading of WWTPs with an additional passive carbon step for the removal of micropollutants. The present work is part of the joint research BMBF project “SchussenAktiv” funded by the German Federal Ministry of Education and Research (BMBF) and the Ministry of Environment, Baden-Württemberg, Germany. In this project, the efficiency of an additional wastewater treatment step based on powdered activated carbon for the ecosystem of the Schussen river, a major tributary of Lake Constance, Southern Germany, has been investigated. This paper focuses on assessing the health status of gammarids and the macrozoobenthos community in the Schussen river. Samples were taken up- and downstream of the WWTP, as well as before and after the upgrading of the WWTP. Gammarid populations from all sites were investigated with respect to sex ratio and fecundity of breeding females. In addition, analyses of heat shock protein (hsp70) levels and lipoxigenases allowed us to draw conclusions about proteotoxic and oxidative stress in gammarids. Macrozoobenthos community integrity was determined by means of the saprobic index as well as by the number of sensitive taxa (EPT index). Prior to the WWTP upgrade, the health status of gammarids as well as the integrity of the macrozoobenthos community was negatively influenced by the WWTPs effluent. After the upgrading of the WWTP, gammarids from the downstream site did not differ any longer from those collected upstream of the WWTP with respect to the investigated health parameters. Furthermore, the overall number of taxa and particularly the number of EPT taxa within the macrozoobenthos community downstream of the WWTP increased distinctly after the upgrade of the WWTP with the additional activated carbon step. We conclude that the efficiency of the activated carbon step to eliminate toxic and estrogenic substances from the effluent can plausibly be related to the improved integrity of macroinvertebrate health and community structure in the connected river Schussen.

Aquatic environments are subject to discharges of multiple contaminants (chemical and biological compounds). Wastewater treatment plants (WWTPs) are ineffective to remove environmental forms of protozoa such as Toxoplasma gondii and Cryptosporidium parvum oocysts or Giardia duodenalis cysts because of their resistance to chemical and physical treatments. These protozoa are clearly identified as a public health priority since they are major parasites of waterborne outbreaks. Many studies underline the interest of using of fresh water bivalve Dreissena polymorpha for biomonitoring. Indeed, this bivalve has a huge filtration capacity leading to an accumulation of chemical and biological contaminants in its tissues. The DROPPE (The dreissene as purifier to protozoa in wastewater treatment plant effluent) project aims to test the depurative capacity of the zebra mussel in terms of protozoa’s contamination in WWTP effluents. To answer this issue, it’s necessary to determine if D. polymorpha is able to live in good health in the multi-contaminated conditions in WWTPs effluent and D. polymorpha is able under these conditions, to bioaccumulate protozoa. For this purpose, two experiments were performed: 1- Zebra mussels were caged in the WWTP’s outlet channel (Charleville-Mézières, France) for 28 days. We studied morphometric parameters, filtration capacity, energetic reserves, enzymes related to oxidative stress (Superoxide dismutase, Catalase, Glutathione S-Transferase and Glutathione Peroxidase) at biochemical and molecular levels. The results suggest that D. polymorpha can maintain itself in effluent for 21 days. 2- D. polymorpha was exposed to different concentrations of protozoa (100, 1000 and 10000 protozoa per bivalve per day) for 21 days followed by 21 days of depuration in laboratory conditions. Detection of oocysts and cysts in tissues and hemolymph of bivalves was carried out by molecular biology techniques. The results highlight a time-dependent and dose-dependent bioaccumulation of protozoa by D. polymorpha. Moreover, the parasite load remains stable during the 21 days of depuration suggesting that the bivalves may have adapted to the bacterial contamination Considering these results, Dreissena polymorpha seems to be a promising tool for protozoa depuration. Keys words: protozoa, wastewater treatment plant, bivalve, depuration

Aquatic macrophytes potential for the removal of water contaminants - The Green Liver Application

S. Calado, Universidade Federal do Paraná / Ecologia e Conservação; M. Esterhuizen-Londt, Technical University of Berlin; H. Silva de Assis, UFPR / Pharmacology; S. Pflugmacher, University of Helsinki

Reservoirs are aquatic environments that are impacted by anthropogenic activities. The main activities around reservoirs in Brazil are agriculture and settlement, increase of nutrients can result in cyanobacterial blooms and cyanotoxins contamination; and settlements can result in inputs of several contaminants such as pharmaceuticals. Iraí Reservoir, located in South of Brazil, is

Pharmaceuticals have been found in aquatic systems globally, due to a combination of worldwide usage and low removal efficiency in wastewater treatment plants (WWTPs), or a complete lack of WWTPs (1). In surface waters, concentrations of pharmaceuticals usually range from low μg l⁻¹ close to point sources to low ng l⁻¹, and are correlated to human population density in the drainage area, volume of the receiving water body and amount of drainage used in WWTPs. One technique to increase the removal of pharmaceuticals in WWTPs is to add a tertiary treatment step based on the addition of ozone. Ozonation is a cost efficient way to degrade chemicals and several studies have shown that most pharmaceuticals are readily degraded in the presence of ozone (2). However, several oxidized degradation products are formed during ozonation and the environmental impact of these are largely unknown. The aim of this study was to investigate the effects of ozonation of WWTP effluents with receiving waters. The overall degree of risk is driven by the toxicity of the input substances and it seems to be a promising tool for protozoa depuration. Keys words: sewage, wastewater, pharmaceuticals, Toxoplasma gondii, Cryptosporidium parvum, protozoa, bivalves, Dreissena polymorpha.
used to water supply and has been reported as contaminated by cyanoxins and pharmaceuticals. Therefore, this contamination increases costs to the water treatment and can cause toxic effects to the aquatic organisms and human health. The aim of this study was to test Green Liver System to remove the contaminants, at the same concentrations that were found in the reservoir, using aquatic macrophytes. Egeria densa, Ceratophyllum demersum and Myriophyllum aquaticum were exposed to concentrations of paracetamol, diclofenac and microcystin-LR using a laboratory model of the Green Liver System for 14 days. Water samples were collected in 0, 1, 3, 7 and 14 days and plants samples were collected at the end of the experiment. Two control experiments were carried out in parallel. Water and plants samples were used to quantify the contaminants and plants samples were also used to evaluate the catalase and glutathione S-transferase activities. Plant species took up the contaminants and the removals of compounds were 93% for diclofenac and 100% for microcystin-LR. Our results showed that the plants antioxidant system was not activated and the Green Liver System was a suitable methodology to clean the water and to implement in phytoremediation programs. Keywords: Green Liver System, Reservoir, aquatic macrophytes, phytoremediation.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health

517 Identifying hotspots of Antimicrobial Resistance Selection in the Natural Environment
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Releases of antimicrobials into the environment increase selective pressures on environmental microbes contributing to the proliferation of antimicrobial resistance (AMR) and perhaps the inevitable ‘post antibiotic era’. One of many challenges in understanding environmental and AMR is the high cost and organisation required to provide widespread environmental monitoring. In lieu of this monitoring data, predicted environmental concentration (PEC) modelling based on pharmaceutical usage data has been demonstrated to be a useful tool in approximating antimicrobial exposures to the environment. Recently, attempts have been made to predict no-effect concentrations (PNEC) for selective pressures in the development of AMR. Coupling PEC and PNEC values provides a powerful tool to estimate the risks associated with a particular compound or class of compounds relating to AMR proliferation. Here we use this approach to identify hotspots where antibiotic exposure may be contributing to AMR selection for a range of different scenarios. Antibiotic usage data, data on metabolism, wastewater treatment and dilution data were used to determine PEC values, which were compared with reported PNECs to determine AMR hotspots for 56 compounds used in Wales as well as 9 chemical classes of antimicrobials in European Countries. Finally, using daily flow data, the approach was applied to a single wastewater treatment utility serving a population of approximately 18,600 persons with effluent discharge into the River Foss, UK to highlight the variation patterns in daily risk associated with AMR selection. Having illustrated the utility of this approach for a range of spatial and temporal scenarios, we believe that these results will be invaluable in informing future monitoring of antibiotics and AMR in the environment.

518 Urban and rural antibiotic resistance
C. Marchant, M. Cooke, Newcastle University; C. Keapp, University of Strathclyde / Civil and Environmental Engineering; J. Su, Y. Zhu, Chinese Academy of Science; D.W. Graham, Newcastle University / School of Civil Engineering and Geosciences
Soils are both a source and a sink for antimicrobial resistance (AMR). Despite growing awareness of AMR in the soil resisting debate continues over responsibility for increased AMR dissemination in this important environmental reservoir. While soil AMR is innate, the relative abundance of antibiotic resistance genes (ARGs) in soil has significantly increased over the last 60 years since the industrialisation of antibiotics. The reasons (e.g., antibiotic misuse, agriculture) for this rapid emergence continues to be debated. It is known that soil pollution is inherently linked to co-selection for ARGs yet limited information exists on large scale, and multi-contaminated sites. This study of 24 locations across the North East of England to evaluate AMR in urban and rural soils with low and high pollution levels. We present pioneering high-capacity quantitative PCR profiles of 230+ antibiotic resistance genes (ARGs) and mobile genetic elements (MGEs). The project has coupled ARGs and MGEs to comprehensive geochemical datasets including 12 metals (total and bioavailable), 16 PAHs, and nutrient conditions to understand the evolution and dissemination of modern antibiotic resistance due to pollution.

519 Dissemination of extending-spectra β-lactamase E. coli carrying multidrug resistance and virulence factors in tropical rivers receiving hospital effluents
A. Luftfe, University of Geneva / Institut Forel; V. Slaveyкова, University of Geneva / Département F.-A. Forel des sciences de l'environnement et de leau; J. Poté, University of Geneva / Department F.A. Forel of environmental and aquatic sciences
The occurrence and dissemination of antibiotic resistant bacteria and their resistance genes from clinical settings to environmental compartment have become a major concern because of serious threat human health worldwide. Given the serious clinical threat of Extended-spectrum β-lactamases (ESBL) and carbapenem-resistant Enterobacteriaceae (CRE), studies are available in many countries from clinical settings. However, there is the dearth of studies in environmental compartments for the presence of these high threat gram-negative bacteria. This situation is particularly alarming in developing countries in which the freshwater resources receive urban and hospital effluent water without previous treatment. Additionally, during the occurrence of this phenomenon, decontamination of ESBL and CRE in sub-Saharan African Countries are very limited. The aim of this research is to assess the role of untreated hospital and urban wastewaters on the biological contamination of urban rivers receiving systems in the city of Kinshasa, Republic Democratic of the Congo. 147 E. coli strains resistant to 3rd generation of β-lactams (ESBL) were isolated from water samples issued along 5 rivers receiving hospital effluents. They were analysed for their clonality and the coexistence of multidrug resistance and virulence genes. The results highlight a high level of clonality in strains (67 clones) and an important level of multidrug resistance regardless the sampling point. 53% of E. coli resistant to the 3rd generation of β-lactams were also resistant between 6 to 8 antibiotics. 14% of ESBL producers also carried virulence genes factors linked to E. coli pathotype determination. The gene β-lactams, monobactams, carbapenems, aminoglycosides, tetracyclin, quinolones and penicil classes of drug were detected in 42% of the strains. These results indicate the human and environmental potential risk of tropical urban rivers. Indeed, ESBL strains carried by urban rivers are associated to resistance against numerous antibiotic classes (i.e. inhibitors combination, 4th generation of β-lactams, monobactams, carbapenems, aminoglycosides, tetracyclin, quinolones and penicil classes of drug) and may also carry virulence gene factors. The presence of multiple-drug resistant E. coli and not only linked to untreated hospital wastewater discharge in urban receiving system are widely distributed along the river, thus highlighting the risk of surface water use.

520 Methods for determining selective endpoints of antimicrobials
A. Murray, University of York; L. Zhang, I. Stanton, University of Exeter; J. Snape, AstraZeneca Global Environment / Medical School; W. Gaze, University of Exeter / Medical School
Antimicrobial resistance is one of the most significant threats to modern society. Use, misuse and overuse of antibiotics clinically and in the community; in agriculture and in hatchery culture results in antibiotics and antibiotic resistant bacteria being released into the natural environment. Environmental concentrations of antibiotics are very low (ng/L range), but recent studies have shown that these concentrations may be sufficient to select for antimicrobial resistance. Currently, antibiotics are not risk assessed in terms selection for antimicrobial resistance in situ. This is largely because there is no standardised ecotoxicological assay which can be used to track selective endpoints. This work compares previously published methods for determining and predicting selective concentrations of antibiotics to two novel methods developed in this study. The first method tracks resistance gene prevalence over time in a complex community using qPCR, and the other is based on reduction in growth of a complex community. Results show that predicted no effect concentrations (PNECs) derived using standard ecotoxicological assays are not always protective against resistance selection. Currently, no single published method for selective endpoint determination is always protective of the other; though there is good agreement between PNECs (PNECs for resistance) published previously and PNECs determined in this study. A novel method, based on growth of a complex community, is proposed for environmental risk assessment as it can be easily standardised, can rapidly generate selective endpoint data, and results show good agreement with more indepth data which tracks resistance gene prevalence over time. Results show that continued data generation and method optimisation is required to develop a reliable assay for determining PNECs for environmental risk assessment of antimicrobials.

521 Determining the minimal selective concentrations of macrolides in a complex microbial community
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Antibiotic resistant bacteria can be selected throughout the microbial community. Continuous release of antibiotics from human activity can and does lead to measureable resistance selection in surface waters (ng/L - μg/L), however these are lower than minimum inhibitory concentrations (MICs) and concentrations used in the clinic. Due to these relatively low concentrations, until recently it was thought that selection for resistant bacteria did not occur within the environment. Research published in 2011 and 2014 by Gaze et al. showed selection at low environmental concentrations using single species assays. The macrolide antibiotics, azithromycin, clarithromycin and erythromycin, were added to the European Commission’s Water Framework Directive’s priority substances.
watchlist in 2015 due to their measured environmental concentrations (MECs) and predicted environmental concentrations (PECs) being higher than their predicted no effect concentrations (PNECs). The aims of this study were to investigate the selective potential of these three compounds in a complex microbial community and to determine minimal selective concentrations (MSCs) for each. A number of week-long evolution experiments were conducted at a range of macrolide concentrations. QPCR determined the presence of a variety of macrolide resistance genes (ermB, ermA, mphA, msrD and mef) at 1000 ng/mL within the community. Change in prevalence of resistance genes, when in the presence of antibiotic, was compared to change in prevalence when no antibiotic was present. Out of all of the genes tested, the ermA gene shows a selective response at the lowest concentration for all three macrolide antibiotics. No significant selection is seen for ermA at 50 ng/mL, but we do see significant selection at 150 ng/mL for all three compounds. The highest current MEC for any of these macrolide compounds is 4µg/L (erythromycin-H2O). Our data suggests, therefore, that current environmental concentrations of the macrolide compounds do not select for resistance genes in a complex microbial community.

522 Impact of multi-year exposure of agricultural soils to antibiotics on the soil resistome and mobilome.
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Antibiotics are entrained into agricultural soil through the application of animal manures and sewage sludge. In order to understand the potential long term effects of antibiotics on soil microorganisms, field plots were established in 1999 that have since received annual applications of a mixture of tylosin, chlorotetracycline and sulfamethazine, and a second series of plots was established in 2010 that receive a mixture of erythromycin, chloramphenicol and azithromycin. Antibiotics have been applied every spring at concentrations ranging from 0.1 to 10 mg kg soil⁻¹, and plots have been continuously cropped to soybeans. A library of large cloned fragments was constructed using DNA sampled in 2014 from plots receiving the highest application rates, or no antibiotics. The library was cloned into antibiotic-sensitive Escherichia coli, and antibiotic resistance genes (ARGs) in the library were discovered by identifying E. coli clones that grew upon plating on solid growth media containing various antibiotics. Genes encoding resistance to many classes of antibiotics including the sulfonamides, tetracyclines, macrolides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e00989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrons and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (eg. int1, sul1, strA) were much more abundant in soils exposed to antibiotics whereas the vast majority of targets were not detectably increased in abundance. Overall, these results suggest that genes associated with integron cassettes are amplified in soil following repeated exposure to antibiotics.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a more realistic point of view
523 Inter-annual monitoring of microplastics in marine intertidal sediments of the Firth of Forth
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Microplastics (MPs) are fragments of plastic smaller < 5mm are commonly found in the marine environment and originate either consumer care products and plastic production plants or from the disintegration of larger pieces. MPs need to be monitored in order to evaluate the effectiveness of Government initiatives to reduce plastic debris in the environment. The aim of the present study, therefore, was to contribute to the development of a hitherto lacking quantitative long-term marine MP database. We present the results of a three-year pilot project in the Firth of Forth, point to innovations in sampling and contamination prevention, as well as the limitations. Sediment samples were obtained in triplicate from intertidal sites in May2014, May & Sept2015, May & Sept2016, 2017 using glass bijoux tubes as miniature cores and sealed with metal screw caps, processed using a density separation procedure and the polymer types determined using FT-IR spectroscopy. The results showed that there are high numbers of plastic particles (34-4,800 kg⁻¹) and fibres (1,700-4,300 kg⁻¹) along both shores of the Firth of Forth. The number of Fibres was generally higher for MPs. There was no apparent pattern of spatial distribution. Although a spike in MP particles was observed between the period September 2015 and May2016, there was no significant difference in MP particle concentrations between May 2014 and May 2017. There was also no significant difference in MP fibre concentrations during the same three-year period. There was also no evidence of seasonal fluctuations in MP concentrations. The results show that, for intertidal sediments in the Firth of Forth, the MP concentration has remained stable. This is significant baseline information and will be instrumental in assessing the effectiveness of Government policy regulating industry and consumer behaviour towards the production and use of particularly single-use plastic products. However, in order to compare results between countries and laboratories, for the purpose of gaining a more global insight into the microplastics contamination issue, more standardized sampling and extraction procedures need to be developed.

Do nanoparticles cause stress effects on microalgae? An infrared spectroscopy study.
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Nanoparticles are constantly used at world level leading to their presence in the aquatic environment leading to possible particles interaction with living organisms. The potential impacts of nanoparticles on living organisms and especially microalgae were observed in 2015 and 16, showing that the mechanisms by which nanoparticles act are not fully understood of the induced mechanisms. Microalgae are the base of aquatic trophic chain and different possible pathways of interaction between microalgae and nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is known to monitoring material chemical composition. In this work, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalgae (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms. Different stresses are realised in this goal: nutrient deficiency, light deficiency, metallic stress, gold and polystyrene nanoparticles. After 48h or 72h of interaction, microalgae are collected and the analysis is performed. We have observed that the nanoparticles are not directly selecting for specific genes expression and the induced stress effects on microalgae cannot be explain by a single type of nanoparticles. The multivariate analysis highlight that microalgae responses are stress dependent. Thus, infrared spectroscopy could be a new method to analyse stress effect on microalgae and particularly nanoparticles. Interaction with nanoparticles seems to induce an overexpression of stress proteins and the metabolic activity, and a better understanding of the polymer types determined using FT-IR spectroscopy.

Ecotoxicological evaluation of high-generation cationic PAMAM dendrimers towards a representative organism of aquatic ecosystems
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Nowadays, nanomaterials are extensively used worldwide in many different fields and their potentially serious effects in aquatic ecosystems have become a global concern [1]. Poly(amideamine) (PAMAM) dendrimers are polymer nanoparticles, radially symmetric, molecules with well-defined chemical structures, positive charge and grafted with amino groups. Their use in biomedicine, as drug carriers, in the development of “smart” materials, is strongly increasing. As a result of this chemical structure, we have investigated the effect of high-generation cationic G5-NH₂ and G7-NH₂ PAMAM dendrimers in a prokaryotic primary producer of aquatic ecosystems, the filamentous cyanobacterium Anabaena sp. PCC7120 (Anabaena). Dendrimers significantly decreased the growth of the cyanobacterium and both dendrimers induced morphological alterations of both filaments and individual cells. Furthermore, cyanobacteria exposure to dendrimers resulted in significant alteration of physiological parameters: increase in the formation of intracellular reactive oxygen species, damage in membrane integrity, membrane potential depolarization, increase of intracellular pH and alteration of intracellular free Ca²⁺ homeostasis. Dendrimers also induced alterations in the photosynthetic responses of Anabaena. In conclusion, high-generation cationic dendrimers exhibited high toxicity towards

526 Interactions of copper nanoparticles and benzo(a)pyrene on marine mussels, Mytilus galloprovincialis
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The production and discharge of nanoparticles has grown extensively over the last few years, raising concerns about the potential impact on environmental health, either alone or in combination with other anthropogenic contaminants. The study, funded by Natural Environment Research Council (NERC), UK aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polyacrylic acid hydrocarbons (PAHs) can interact with each other to differentially modify their potential toxicity. To probe this hypothesis, marine mussels were exposed for 3 days to benzene (only) and two different types of carbon nanoparticles, [C60 fullerene and multi-walled carbon nanotubes (MWNNTs)], both alone and in combination with BaP. Tissue specific distributions and concentrations of CNPs and BaP were determined in exposed mussels. To enhance the analytical traceability of these CNPs in biological systems, some nanoparticles were labelled with rare elements. CNP uptake was followed by ICP-MS and/or HPLC-UV, with the BaP uptake tracked by GC/MS. CNP uptake was also investigated by electron microscopy. The genotoxic effects were characterised by the level of DNA strand breaks (comet assay), microcinuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technology targeting 15 stress response pathways. Contrasting results were obtained. As far as the type of carbon nanoparticles used, carbon nanoparticles dissolved (mussel) and MWNNTs both show a decrease in the BaP concentration in the digestive gland. Conversely, co-exposure to C60 and BaP seems not to affect the uptake and genotoxic effects of BaP. Different responses were also observed with the transcriptomic studies. Microarray analysis identified several key biological processes (e.g. DNA metabolism, cytoskeleton, oxidative stress and heat shock protein family) that are up-regulated by the different types of nanoparticles used. The data may have implications for the development of new genotoxicity markers and for the risk assessment of nanoparticles.

527 Trophic transfer of CuO NPs and Aqueous Cu: from worms to fish - a proof of concept study
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Nanostructures (NPs) will inevitably end up in the aquatic environment, where they will settle out and accumulate in the sediment. Therefore benthic fauna is at particular risk to the uptake of these nanoparticles and nanoparticulate metals have been reported for different benthic invertebrates, which serve as foraging organisms of fish. Here we examine if transfer of copper (II) oxide (CuO) NPs and dissolved copper (administered as CuCl2) can occur from sediment to worms (Tubifex tubifex) and further from worms to fish (Gasterosteus aculeatus). CuO NPs (< 50 nm; Sigma) were characterized with regard to primary particle size, shape, hydrodynamic diameter and dissolution at different experimental conditions using TEM, DLS, PALS and ultrafiltration followed by ICP-MS analysis, respectively. Worms were exposed to sediment amended with CuO NPs or CuCl2. Cu concentrations in sediment, overlaying water and worm tissue were determined using ICP-MS. In addition, the metal binding protein metallothionein (MT) was quantified with DPP (differential pulse polarography). Fish were exposed for up to 7 days to worm-shaped CuO NP and CuCl2 spiked food packages produced from uncontaminated tubifex homogenates (2 μg Cu/g fish/day). Cu concentrations were measured in intestine, liver and carcass using ICP-MS. In addition, intestinal and hepatic mRNA expression levels of genes relevant for Cu uptake, storage and toxicity including metallothionein A (mta) were measured using RT-qPCR. The total Cu body burden of tubifex increased by 3 and 3.5 μg Cu/dw tissue after 7 days of exposure in CuO NP- and CuCl2 spiked sediment, respectively, suggesting that NP uptake into the organism occurred. Cu accumulation was also observed in fish receiving CuO NP and CuCl2 spiked food packages, in particular in intestine, and was concomitant with upregulation of mta transcription. The increase in the internal Cu concentration and mta expression in CuO NP-exposed fish was higher than in the control, but did not reach levels measured in CuCl2-exposed fish. At the same time the amount of Cu egested with the faeces was significantly higher than in the CuCl2-treatment. These results suggest that transfer of CuO NP along the food chain may be limited compared to dissolved Cu. We suggest future studies on how NP bioavailability and accumulation in fish is influenced by other important factors, such as exposure dose, time and NP properties upon biotransformation by the foraging organism.

528 Corbicula fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study
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Engineered nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO ENP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their bioavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic freshwater bivalve Corbicula fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosm containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 μg CuO/L at the end of the exposure period (28 d). Behavioral, physiological, biochemical and molecular parameters were quantified in order to assess CuO ENP impacts on C. fluminea. Results of this study allow to conclude that CuO ENP affected C. fluminea below CNRS UMR 7360 / LIEC CNRS. Engineered nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious.
531 Assaying the proxidant and antioxidant potentials of nicotine products: Tobacco versus electron cigarettes
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Cytotoxic oxidating potential from imbalance between the production of reactive oxygen species and the efficacy of the antioxidant defense, can be a consequence of using the nicotine products. Prooxidant properties of the tobacco smoke are accounted for by the abundance of the smoke oxidants. The antioxidant potential of the smoke is scantily addressed in the literature. However, one should take into account that any reactant in oxidation process may exhibit both oxidant and antioxidant propensities depending on the reaction conditions. And different have shown that smoke constituents indeed exhibit at the same time both proxidant and antioxidant activities. Such smoke-borne antioxidants may be assessed through both the direct chemiluminescence (CL) derived from the smoke samples as a function of the smoke tar content and using the probe CL preparations of hydrocarbon substrates being oxidized. In addition to exogenous antioxidants derived from the tar, tobacco smoke was studied for the presence of active proxidant generation directly in smokers. For that purpose, we have developed a novel assay based on the CL of luminol, which involves tobacco-smoke extracts, peroxidase and amino acids. Using such a system, we have demonstrated that under physiological conditions the oxidation of the smoke tar and its individual components, e.g. catechol, in the presence of H$_2$O$_2$, peroxidase, and glycine affords the products (first of all, catechol-glycine adducts) whose antioxidant potential is much higher than that of initial, unoxidized, chemicals. Conversely, we have not observed any significant antioxidant activity of aerosols derived from electronic cigarettes (ECS). For ECS, the following feature is noteworthy. We have found for the first time that all ECS, regardless of their technical complexity, generate in their exhalation (from mouth of the smoker) $10^3$ of precursor glycine (the main component of e-liquids served as solvent for nicotine, which are potential proxidants (ROS sources), whose physiological significance still requires elucidation. The content of these products depend on the type of EC and on the mode of its use, which makes possible to minimize the ROOH generation. The CL methodology has proved to be the most useful tool in assessing the oxidant and antioxidant potentials of nicotine containing aerosols, i.e. tobacco smoke and emissions from ECs, which exhibit essentially different impact on oxidative developments in a smoker’s organism.

532 The possibilities of using fungal fluorophores to assess responses of filamentous fungi to external stimuli
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The interest to functional and structural indicators of mycobacteria with a respective to use them in biodiagnostics is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biodiagnostics is explained by the diversity of reactions to external stimuli, which determines their phenotypical and biochemical plasticity. In this regard, it seems very important to find the reactions of fungal cultures adequately reflecting their response to external stimuli in different conditions. The essential biogenic fluorophores such as NADH, tryptophan, melanin, ergosterol, pyridoxine, riboflavin, FAD, and FMN can be monitored instrumentally by spectroscopic techniques. The aim of the present study was to investigate the features of fluorescence spectra of fulamentous fungi cultivated under different concentrations of source of bioavailable and nor readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chalosporium chalosporioides, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi aerobically cultured and agar Czapek medium contained a varying level of sucrose (0.3 and 3%) and humic substances (0.02 and 0.1%). Fluorescence spectra were measured using a luminoscope spectrometer Solar CM2203 at several wavelengths of the excited radiation (250, 300, 315, and 450 nm). Fluorescence excitation spectra were recorded for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (smoke, in the presence of the products) showed two bands of overlapping bands. The UV-band with maximum at 300-350 nm under excitation at 280 nm is a protein-like fluorescence, and the band in the blue region with the maximum at 400-450 nm under excitation at 310-370 nm is emission of fungal chomophores like NADH and or melanins. And we have shown that humic surface characteristics stand out as one of the most important, if not the main, determinants of biological performance, as the nanoparticles (NPs) surface is the most prominent and earliest point of exposure. Complexity of this issue is that the coordination of ligands on the surface of NPs can significantly enhance subsequent cytotoxicity. The principal challenges that have to be addressed are a detailed understanding of how the NPs' original 'engineered' surface chemistry influences subsequent NP interactions with biosystems. In this work results of a complex study of Fe$_2$O$_3$ functionalized by humic acids (HA) were described. We hypothesized that, along with the NPs size, the surface functionalization was a major factor contributing to sorbent toxicity mitigation. The average particle size calculated by the Scherrer equation tended to decrease from 8.4 nm for Fe$_2$O$_3$-HA20 to 4.5 nm for Fe$_2$O$_3$-HA80. Optical spectroscopy indicated that the fluorescence quantum yield depended on the HA content in the nanocomposite and confirmed that the humic component interacted with ferric ions. Biosafety of Fe$_2$O$_3$-HA NPs was investigated in laboratory biostest systems using algae, infasorins, and higher plants as test-cultures. Concentration limits for using the Fe$_2$O$_3$-HA NPs suspended in water under controlled artificial conditions were found experimentally by ecotoxicological tests. Experiments with this "battery" of three biostests showed that, in controlled chemical conditions, water suspensions of the preparation can be safely used for biota given a certain concentration limit. It was found that samples of bare Fe$_2$O$_3$ and the Fe$_2$O$_3$-HA80, 0.01 (%), were remarkably more toxic than water suspensions Fe$_2$O$_3$-HA20 and Fe$_2$O$_3$-HA50 in this concentration in biotests with Sinapis alba L. 100 times increase in concentration revealed that the effective concentration (EC$_{50}$) for Sinapis alba did not exceed 0.1% Fe$_2$O$_3$. With that, algae appeared more sensitive: EC$_{50}$ was 0.01% in the biotest with Scenedesmus quadricauda for Fe$_2$O$_3$, Fe$_2$O$_3$-HA50, and Fe$_2$O$_3$-HA20. Humic substances in natural conditions are likely to increase the permissible concentration limit and to mitigate harmful impact of the NPs. Obviously, before applying such remediation agent in specific biotope conditions, its biosafety should be additionally assessed by the bioindication method based on response of biotope inhabitants.

534 Poster spotlight: WE209, WE210, WE211
Obesogens and lipid disruptors
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The evolution of obesogen-induced phenotypes in vertebrates
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Global obesity is an escalating pandemic in western societies. Triggered by numerous environmental and genetic factors, this epidemic condition is also influenced by individual and environmental cues. Of note are the globally persistent man-made chemicals, with ever-growing ecological consequences, a hallmark of the Anthropocene epoch. A striking example highlights the role of a group of compounds known as “obesogens”. In mammals, most examples involve the modulation of the peroxisome proliferator-activator receptor (PPAR) nuclear receptor. To decipher the pattern of PPAR exploitation by a model obesogen, tributyltin (TBT), we employed an extensive analysis from comparative genomics to transactivation assays, site-directed-mutagenesis, and homology modeling, to unfold the structural and biological determinants of PPAR exploitation by TBT. Our findings endorse the modulatory ability of man-made chemicals and suggest an evolutionary divergent setting of “obesogenic” responses to TBT, with impacts for human health risk assessment.

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Aging Extension and Modifications of Lipid Metabolism in the Monogonont Rotifer Brachionus koreana under Chronic Caloric Restriction
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Transforming the aging relationship of the aging extension and modification of lipid metabolism under chronic caloric restriction (CCR; concentration from 0 to 100% of the diatom Tetraselmis suecica) in the monogonont rotifer Brachionus koreana, we assessed the life cycle parameters, fatty acid composition, and sirtuin and lipid metabolism-related genes expression. As a result, in the 5% exposed group, B. koreana showed the decreased life reproduction. Based on this finding, we chose 5% of T. suecica and performed the rest of the experiment compared to 100%. As a result, up-regulation of sirtuin genes expression was observed. In addition, despite the reduction in the amount of total fatty acid (FA) and the area of triacylglycerol, the increase observed. Furthermore, the mRNA expression of Δ9 desaturase confirmed that CCR promoted the synthesis of MUFA through Δ9 desaturase. Moreover, the expression of docosahexaenoic acid (DHA) synthesizing gene, Δ4 desaturase, has also been up-regulated along with DHA content. These data suggest that CCR modified histone acetylation and lipid metabolism, leading to decrease in reproduction, consequently resulting in life span extension.

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Lipidomic and transcriptomic changes induced by compounds enhancing accumulation of storage lipids in Daphnia magna
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The analysis of lipid disruptive effects in invertebrates is limited by our poor knowledge of the lipid metabolic pathways and of their complete lipidoma. Recent studies showed that tributyltin and juvenoids activated the ecdysteroid, juvenile hormone and retinoic X receptor signalling pathways, and disrupted the dynamics of triacylglycerols in lipid droplets in the crustacean Daphnia magna. This study aimed to explore how ecotoxicants, juvenoids and bisphenol A disrupt the dynamics of phospholipids and neutral glycerolipids in adult daphnias during the reproductive cycle from both lipidomic and transcriptomic points of view. Comparison of the lipidomic profile between treatments and controls revealed relative abundance changes for 194 out of 235 individual lipids detected, corresponding to three classes of neutral glycerolipids (TAGs, DAGs, MAGs) and nine of phospholipids (PCs, LPCs, PEAs, LPEAs, PSs, LPSs, PGs, LPGs, SMs). Cluster analysis defined two major clusters, one corresponding to control, BPA and 20E samples, with low levels of TAGs but higher levels of PCs; and another one corresponding to juvenoid-treated samples (PP and MF), with higher levels of TAGs and lower levels of PCs. In addition, subclusters corresponding to lower and higher exposure time were also observed. Transcriptomic analyses identified 1,964 de-regulated genes that were clustered in three groups corresponding to up-regulated gene transcription after either 8 or 24h of TBT exposure, and to up- and down-regulated genes after 24 h of exposure to BPA, PP, or TBT. Gene ontology analysis indicated an enrichment of gene signalling pathways involved in lipid metabolism, specifically in lipid catabolic process, triglyceride homeostasis, glycolipid biosynthesis or fatty acid beta-oxidation. This work as supported by the Spanish Research Project EMRISK Code CTM2014-51985-R, (2015-2017). Inmaculada Fuertes acknowledges the Ministry of Economy, Industry and Competitiveness for her fellowship (FPI-MICINN BES-2015-075023).

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Lipidomics profiling of wild fish to identify patterns associated with pollution exposure
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New developments of analytical techniques have allowed the effective identification and characterization of lipids and the development of lipidomics, which has recently emerged as a key technology for human disease research and discovery of biomarkers. However, on an environmental toxicology context, studies are still few, in spite of lipids being considered key molecules for the bioaccumulation of chemicals. This work applies ultra-high performance liquid chromatography coupled to high resolution mass spectrometry (UPLC-HRMS) to characterize the lipidomic profile of the fish species Barbus meridionalis, Squalus laienatus collected along the Ripoll River. Sampling sites included upstream (reference) and downstream (urban and industrial discharges) areas. A total of 130 lipid species, including phosphatidylcholines (PC), PC-plasmalogens (PC-P), cholesterol esters (CE), triacylglycerols (TG), diacylglycerols (DG) and sphingomyelins (SM) were detected in the muscle tissue. Partial least squares discriminant analysis (PLS-DA) allowed a clear separation of the lipidome of fish from polluted and reference sites. Specifically, a relative increase of CE5 (18:1, 20:4, 22:5, 22:6) and some PC-Ps (32:0, 36:4, 36:5, 38:6) was detected in the muscle of B. meridionalis sampled in polluted sites. In contrast, the lipidome of S. laienatus from polluted areas was characterized by a significant increase of TGs and PC-PS and a concomitant decrease of PCs with a high number of double bounds (36:5, 36:6, 38:6, 40:6, 40:7). The results suggest potential lipid oxidation of highly unsaturated PCs, particularly in S. laienatus living in polluted sites together with a concomitant increase in neutral lipids (TGs, CE5), possibly due to an increase in the energy demand to respond to stress in polluted sites.

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Lipidomics profiles distinguish fish from organochlorine pesticide contaminated lakes compared to control lakes
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The organochlorine pesticide (OCP) contamination of two like Apokka largely derived from high application use in the muck farms on the North Shore. These practices were discontinued in the 1970’s but fish in Lake Apokka continue to have relatively high body burdens of organochlorine contaminants. Previous transcriptomics experiments have indicated that the OCPs alter endocrine related endpoints in ovary and liver of exposed fish. In addition, changes in lipid transport and metabolic pathways are affected. Current work explores changes in the lipidome of largemouth bass caught in Lake Apokka compared to fish from a relatively clean lake in the Ocala National Forest. We used both a shotgun approach and a targeted approach to quantify perturbations in phospholipids in liver of largemouth bass from Lake Apokka compared to a relatively clean lake. Follow up experiments with fish exposed in the laboratory support the changes seen in the field. Cholesterol was decreased and cholesterol esters were elevated in the livers of fish from Lake Apokka compared to Wild Cat Lake. This finding corroborates reduced hormone biosynthesis in organochlorine contaminated fish. Other changes in the lipidome are consistent with predicted changes that are related to immune dysfunction. Enrichment in Lake Apokka fish was observed in short chain length free fatty acids, such as palmitic acid and in ceramides, phosphatidic acids and phosphatidylcholins. But decreases were observed in sphingomyelins, phosphatidyl-ethanolamines and other phospholipids. These changes are consistent with lipids that are changed due to inflammation and other immune responses. We postulate changes in the lipidome are important biomarkers of OCP contamination.

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Poster spotlight: WE027, WE028, WE029

Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (II)

541
Nanotechnology: When shading effects through agglomeration of carbon nanotubes (CNT’s) are confused with toxicity by media and the public - a case example revisited
O. Schwab, Adolphe Merkle Institute / Materials Science
Engineered nanomaterials are relatively new contaminants with that can enter the environment via an increasing variety and number of waste streams. The long-term toxicity of nanomaterials is not well understood, and these materials are therefore of emerging public concern. In 2011, we published a press release about our scientific publication on the effects of carbon nanotubes on green algae [1]. We found that the nanoparticulate under investigation did not directly affect the algae viability, but indirectly reduced the algal growth via shading and agglomeration. To our surprise,
this press release led to a cascade of secondary articles and events. On the one hand, some online newspapers used our article to produce alarming articles about the dangers of nanoparticles for the environment (example translated from German: “Nanoparticles Identified as Potential Environmental Killers” [2]). On the other hand, some individuals used the press release to draw the oversimplified conclusion that all engineered nanomaterials will eventually agglomerate and therefore be harmless. Nevertheless, most of the media took over the message with no or minor modifications. The press release also triggered surprising responses from within the research institutions. In this presentation, I was invited to briefly summarize the different responses that went to this press release, and re-iterate the short- and long-term lessons learned from this case study. Most importantly, the ‘real’ work for a scientist writing a press release starts after its publication. News on topics of public concern such as the toxicity of engineered nanomaterials are very closely watched and instrumentalized both by the pro- and the anti-nano community for their respective intentions. Reactions on press releases concerning these topics have to be monitored closely, wrong quotations must be corrected and biased interpretations must be adjusted, in order to provide correct scientific information for the common public. The reward for this work is an overall more balanced communication of the results. [1] Schwab F, Bucheli TD, Lukhele LP, Magrez A, Nowack B, Sigg L, Knauer K. 2011. Are carbon nanotube effects on green algae caused by shading and agglomeration? Environ Sci Technol 45:6136-6144. [3] Georgescu V. 2011. Nanopartikel als potenzielle Umweltkiller ausgemacht. www.lifeigen.de/news/ShowNews.php?id=7047&getnews=3m2011-11-09-3109&pc=pc02. Accessed 22 Nov 2017 Acknowledgements and Disclaimer - Schwab, F was supported by an Ambizione fellowship of the Swiss National Science Foundation (grant number 168187). Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the Adolphe Merkle Institute or the SNSF. This work has not been subjected to their review and no official endorsement should be inferred. The author reports no other conflicts of interest and is responsible for the content of the abstract and presentation.

542 Nanotechnology: Communicating scientific findings through media – what could possibly go wrong? Lessons learned from Schwab’s nanotubes G. Obereg, UBC / BIES; A. Seal, University of British Columbia / School of Journalism
There is no single effective method for scientists to communicate their findings with the media. Unfortunately, Dr. Fabienne Schwab found this out after publishing a press release about the effects carbon nanotubes (CNTs) have on green algae. When the story hit the press, mainly through an article in Der Spiegel, many readers understood CNTs to be toxic. As a result, Dr. Schwab and her colleagues were accused of fear-mongering. Things escalated to the point that Der Spiegel had to shut down the article’s comments section. Where did things go wrong? How can scientists make sure the media presents their work accurately, but also in a way the general public can understand? We will discuss the diverging roles and realities of science and media, particularly the considerations that scientists and editors need to take into account when they decide to write/publish something.

543 Discussion Nanotechnology

544 Microplastics: The risks of plastics – perceived or real? M. Kotterman, IMARES / Fish
Plastic has not only become a major research topic, it is also broadly covered in popular news. As result the general public knows about the plastic soup and how dangerous it is, supposedly, for wildlife and ultimately for human health. However, the history of plastic research is peculiar. Some of it was straightforward; wildlife choking in plastic does not need much additional proof or QC QA. But, as with many new research topics, the first articles about the dangers of plastic were soon followed by others. The focus was on the presence of small plastics particles even from the seafood, honey to even drink of different actors related to each story, but also to the society at large, from children to adults, trying to test the changes in those attitudes. The products include videos, cartoons, serious games, interactive tools, specialized courses, etc. Our aim is that if scientists and society have a shared understanding of science and risk communication regarding the problems of the oceans, these can be solved through the individual and collective changes in our attitudes towards the oceans in our daily lives.

545 Lost in translation: Do we communicate the risks of (micro)plastics in the right way? M. Wagner, Norwegian University of Science and Technology / Department of Biology
While research on the environmental and health risks of microplastics is still in its infancy, the public has already concluded there are unacceptable risks and, consequently, demands for action. This puts environmental toxicologists and chemists in an uncommon position, namely that public awareness of a potential environmental issue is way ahead of an evidence-based assessment of the actual risks. To further complicate the matter, researchers face a fundamental dilemma: Current narratives on the negative implications of (micro)plastic pollution create public awareness and promote change towards more sustainable economic practices, e.g., with regard to circular economy. However, these narratives are in many cases not backed by scientific evidence. The question is now: How can we promote positive societal change and at the same time stay true to the scientific principles? In my talks, I will not present final answers to this question but rather provide a diagnosis of the recent microplastics debate. I will argue that plastic pollution represents a challenge to our disciplines with regard to the following fundamental aspects: 1) absence of a common risk understanding, 2) bias when dealing with information-scarce situations, 3) lack of mechanisms to prioritize environmental issues, 4) lack of mechanisms for consensus-building regarding the risk of environmental stressors. I will further argue that the field of plastics pollution represents an ideal playing ground to explore, discuss and advance these aspects. This will be crucial to get our disciplines fit to deal with the wicked problems, we face in the Anthropocene.

546 Ocean Literacy – changing attitudes and behaviour of society in the face of the problems of the oceans
A. Borja-Arte-Tecnalia / Marine and Coastal Environmental Management
The H2020 project ResponSEAbBLE (www.responseseable.eu) is trying to raise awareness among six key-stories (fishing, eutrophication, renewable energies, coastal tourism, microplastics, and ballast waters), within the four European regional seas. Under the DAPSIWRM framework (Drivers, Activities, Pressures, State, Impact, Wellbeing, Responses, Measures) we are developing products to change attitudes and behaviour of different actors related to each story, but also to the society at large, from children to adults, trying to test the changes in those attitudes. The products include videos, cartoons, serious games, interactive tools, specialized courses, etc. Our aim is that if scientists and society have a shared understanding of science and risk communication regarding the problems of the oceans, these can be solved through the individual and collective changes in our attitudes towards the oceans in our daily lives.

547 Discussion Microplastics

548 General discussion with panel of all speakers about topics emerging from the session

549 Wrap-up and closing
A. Leopold, Calidris Environment BV / Calidris Environment BV; T. Seiler, RWTH Aachen University / Ecosystem Analysis; C. Aajo, ECHA-European Chemicals Agency
Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (I)

550 Development of a diagnostic toolbox for ecological effects of pollutant mixtures and application to evaluate results from the third joint Danube survey
A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; T. Seiler, RWTH Aachen University / Ecosystem Analysis; M. van den Brink, Alterra Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University
There is evidence that single substances that are the thresholds of effect can still be of concern and contribute to combined effects. A toxic chemicals from point and diffuse sources might impact the ecological status of aquatic ecosystems. Appropriate strategies are needed to identify impacted sites, quantify impacts, or evaluate the causative involvement of chemical contaminants. Since environmental compartments usually contain mixtures of chemicals with low, possibly non-toxic concentrations of the individual compounds, any approach to the assessment of biological impacts and chemical contamination has to involve concepts for mixture toxicity. However, in addition to toxic chemicals, other non-chemical stressors such as habitat degradation, nutrient pollution, oxygen depletion, pH shifts, hydromorphological changes or others, may also cause a site to fail achieving good ecological status. Since the EU Water Framework Directive (WFD) aims at a good ecological status of all European water bodies through addressing water pollution, for water quality monitoring and assessment under WFD it is necessary to discriminate the impact of such non-chemical stressors from the effects of toxic chemicals. This is challenging, and no single “one size fits all” strategy exists. Therefore, multiparametric approaches, so-called “toolboxes”, are often used. This presentation will show a toolbox for the detection of the ecological impact of chemicals that was developed within the Solutions EU project. It uses a statistically supported, health-based and formalized assessment called WOE (Wildlife Occurrence Estimation) and how the concept could be operationalized. In the presentation, we will provide the background of existing approaches to define “mixture risk drivers” and explore the consequences of their application to a real-world dataset (Swedish pesticide monitoring data). In particular, we will demonstrate that the use of Concentration Addition, which is common in all approaches, might not always be justifiable for the ranking of mixture components. Additional we will discuss: (i) the sensitivity of the various methods to data gaps, (ii) the challenge of tiering the various approaches for risk driver identification, and (iii) the question whether a risk-based ranking is the optimum approach, or whether hazard- or exposure-based methods can be suitable alternatives. In summary, we conclude that, although the identification of risk drivers of mixture risk would constitute a major step forward to systematize and simplify the seemingly overwhelming complexity of chemical exposures encountered during human health and environmental risk assessments, the concept is currently not yet fit for purpose. Important steps remain to be taken, in order to better conceptualize and operationalize the concept. However, more and more empirical data become available from monitoring studies that provide ample material to explore the applicability of the concept and its consequences for risk management.

### 552 Application of new statistical distribution approaches for mixture risk assessment

**A. Kortenkamp, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health**

Mixture relevant for human health or the environment can easily contain dozens or even hundreds of chemicals. However, those components do not contribute equally to the mixture risk. The European Commission to the mixture risk. The European Commission to the mixture risk. The European Commission to the mixture risk. The European Commission has emphasized in its communication the need to “identify chemical substances that are the main drivers of mixture toxicity”. This could tremendously help to steer future chemical monitoring efforts and risk mitigation measures. However, it is currently unclear how a common definition of the term “driver of mixture toxicity” exists, and how the concept could be operationalized. In the presentation, we will provide the background of existing approaches to define “mixture risk drivers” and explore the consequences of their application to a real-world dataset (Swedish pesticide monitoring data). In particular, we will demonstrate that the use of Concentration Addition, which is common in all approaches, might not always be justifiable for the ranking of mixture components. Additional we will discuss: (i) the sensitivity of the various methods to data gaps, (ii) the challenge of tiering the various approaches for risk driver identification, and (iii) the question whether a risk-based ranking is the optimum approach, or whether hazard- or exposure-based methods can be suitable alternatives. In summary, we conclude that, although the identification of risk drivers of mixture risk would constitute a major step forward to systematize and simplify the seemingly overwhelming complexity of chemical exposures encountered during human health and environmental risk assessments, the concept is currently not yet fit for purpose. Important steps remain to be taken, in order to better conceptualize and operationalize the concept. However, more and more empirical data become available from monitoring studies that provide ample material to explore the applicability of the concept and its consequences for risk management.
assumptions about modes of action are introduced. We tested the utility of the scheme by using data on the levels of more than 300 chemicals that occur together in the river Danube, from the Joint Danube Survey 3 (JDS3). For each of the 54 sites along the river Danube we ranked the chemicals in terms of their contribution to a mixture effect, separately for algae, daphnia and fish. We found that the overall mixture toxicity was driven by only approximately 10 chemicals. Substances not yet defined as priority substances under the EU Water Framework Directive made a substantial contribution to combined exposures. We also assessed possible combined risks to humans by evaluating whether water drawn from the Danube would be fit for human consumption. Overall, exposures of concern for humans could not be detected at higher tiers of the assessment. We conclude that the protection goals defined in the Water Framework Directive for freshwater aquatic communities are not achieved for combined exposures at many sites along the Danube.

555 Pesticides do rarely come alone, except in risk assessment - Risk indices of ranked spray series of the project COMBITOX

B. Scholer-Starker, RWTH Aachen University / Institute for Environmental Research / Institute for Environmental Research; S. Bar, German Federal Environment Agency UBA / Section Plant Protection Products; B. Daniels, RWTH Aachen University / Institute for Environmental Research; T. Frische, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology; R. Ottermanns, M. Röß-Nickoll, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; A. Sybertz, RWTH Aachen University / Institute for Environmental Research; C. Ullrich, German Federal Environment Agency UBA / Section Plant Protection Products; S. Knüllmann, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology.

In the European Union, legislation so far strictly regulates plant protection by means of chemical pesticides on the level of single products. Common agricultural practice and manifold pest pressures lead to the exposure of non-target organisms to complex mixtures in a spray series. In the on-going COMBITOX project, we collated a dataset for the actual application patterns of pesticides in 12 representative crops in terms of acreage and pesticide application rates from the years between 2007 and 2015. The data was used for classification of sprayseries by typical mixture patterns, sequences and toxic potentials. Combining all information on empirical use patterns and their regional and temporal variation, we calculated indicators of use intensity and environmental risk. Toxicity exposure ratios (TER) were calculated using standard toxicity data (aquatic & soil organisms) from two publicly available databases (PDDB (Lewis et al. 2016) and ECOTOX (US EPA 2017)) and the mere application rates without consideration of exposure pathways. Only for focal sprayseries, first and higher-tier risk indices (including mandatory risk management measures) for different compartments were computed according to the standard approach as conducted by the UBA within the PPP-authorization procedure in Germany. In sum, 29 risk indices were computed (TER (single), TER (multiple)). Risk indices were calculated based on the concept of concentration addition from single-substance TER and summed up per application date. In general, patterns of pesticide use showed that tank mixes and spray sequences are predominantly in all crops that were considered in our studies. From the data, we revealed that crops group together in classes of use patterns. The cereals received a wide range of different pesticides classes in medium intensities during the whole spraying sequence; vine and apple orchards were dominated by fungicides and high-intensities. Risk exceedances became relevant if multiple individual TER-values (TERsingle) were already close to the critical TER trigger values. Our results emphasize the relevance of the nowadays largely non-regulated tank mixes for the risk assessment of non-target organisms. In conclusion, we clearly see the necessity to consider realistic exposure assessments of typical treatment regimens as well as effect estimates from appropriate mixture toxicity models in order to describe the “total risk” of the common chemical plant protection practice.

Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (I)

556 Time-dependent effects of two fungicides and their mixture on enchytraeid and earthworm communities under field conditions

J. Amoss, S. Bart, INRA/AgroParisTech; C. PELOSSO, INRA (Institut National de la Recherche Agronomique) / INRA AgroParisTech. According to the current regulation for the registration of plant protection products on the market, the environmental risk assessment of pesticide use is generally performed under laboratory conditions. Very little information is available in nature, where multiple stresses occur. In this study, we assessed the effects of two commercial formulations of fungicides, i.e., Cuprafor Micro® (composed of 500 g·ha⁻¹ of oxycarboxylic acid and 133 g·ha⁻¹ of dimoxystrobin), and the mixture of both on two groups of terrestrial oligochaetes (Lumbricidae and Eucytheridae) after 1, 6 and 12 months (i.e., t1, t6 and t12) of exposure under field conditions. We also assessed the feeding activity of soil organisms using the bait laminar method. Our results showed a lower Shannon index for earthworms in the treatment with the mixture of both pesticides (i.e., 1.51 ha⁻¹ of Swing Gold® and 4.9 ha⁻¹ of copper) and in the treatment with the Swing Gold® at ten times the recommended dose (i.e., 1.51 ha⁻¹) after one and six months. We also found a lethal effect of Swing Gold® on anecic earthworms at t1, while an effect of copper on anecic species was observed at t12. Enchytraeid community and other functional endpoints (e.g. organic matter decomposition with the tea bag method) over two years to better assess environmental risks of plant protection product use and their mixture. Keywords: Cuprafor Micro®, Swing Gold®, agroecosystems, feeding activity

557 Toxicity of imidacloprid and thiacloprid towards four Colembolan species C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; C. van Haren, G. Maintainer, Vrije Universiteit Amsterdam / Department of Ecological Science; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

Folsomia candida has been used for assessing the toxicity towards non-target soil organisms to pesticides. The first studies using this species were published in 1970s. Thiacloprid was tested on F. candida in several studies in the 2000s, and since then, the insecticide imidacloprid has been widely used. Both pesticides are neonicotinoids that have been extensively used over the past decades. In fact, they are among the most commonly used pesticides worldwide and have been associated with various environmental issues. In this study, we aimed to assess the toxicity of imidacloprid and thiacloprid on F. candida, F. fimetaria, F. fimetaria, and F. candida in the field. We used field samples collected from the vicinity of the Utrechtse Heuvelrug nature reserve in the Netherlands. The samples were taken from different soil types, including garden soil, meadow, and forest soil. The toxicity of the pesticides was evaluated using the standard OECD assay for soil biota. We also investigated the effect of exposure duration on the toxicity of the pesticides and whether the effect was dependent on the soil type. Our results showed that the pesticides had a significant effect on the survival of F. candida and F. fimetaria. However, the effect was more pronounced in F. fimetaria than in F. candida. We also found that the survival of F. candida was more affected by the pesticides than the survival of F. fimetaria. In conclusion, we can say that imidacloprid and thiacloprid are toxic to F. candida and F. fimetaria in the field.

558 Dirty dancing: measuring mito movement responses to pesticide residues J. Wirtton, Environment Dept, University of York / Environment; T. Alvarez, EcoRisk Solutions Ltd / Dept of Ecological Sciences; M. Reid, HSE Health and Safety Executive / Chemicals Regulation Division; G. Wey, ADMAD; M. Hodson, University of York / Environment Department; R. Ashauer, University of York / Environment.

For a pesticide to be registered for use, the lethal and sublethal effects on non-target arthropods (NTAs) must be studied. Sublethal effects such as behavioural changes have been reported in NTAs exposed to some pesticides, with avoidance behaviour – i.e., individuals displaying a significant reduction in movement or staying away from a pesticide – being of particular interest. More research is necessary to better understand pesticide avoidance behaviour so that population consequences of such behaviour can be estimated. We aimed to develop an efficient method to quantify changes in movement behaviour and identify avoidance behaviour in relation to pesticide exposure in the predatory mite Typhlodromus pyri, a model species and nematode predator found in fruit orchards and vineyards. Using video analysis, we exposed individual adult mites to 3 insecticidal active ingredients (acetamiprid, deltamethrin, dimethoate), each at 3 concentrations, and evaluated mito movement behaviours when exposed to these in comparison to a control arena. We found that distances walked by mites were reduced by up to 87% compared to the control when exposed to 0.1 μg·m⁻³, deltamethrin, and that 54% of individuals exhibited repellence through becoming trapped in the test arena glue boundary at this concentration compared to 0% in the controls. When exposed to 18 μg·m⁻³, acetamiprid mean distance covered fell by 34%; however, when exposed to 0.45 μg·m⁻³ dimethoate the mean distance covered increased by 11%. No individuals

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exhibited avoidance behaviour when exposed to acetamiprid or dimethoate. We report the variable effects of 3 insecticides on a range of standard movement behaviours in T. pyri, including distance walked, time moving/not moving, velocity and meandering behaviour. We also report avoidance behaviour measured as the time taken to become trapped in the test arena glue boundary due to escape attempts to escape the arena. Our results complement existing knowledge of sublethal pesticide effects in T. pyri by quantifying movement behaviour changes in T. pyri. We are also adding to the knowledge on movement behaviour which is an area of growing interest. We hope to improve the understanding of population-level consequences from changes in movement behaviours caused by pesticide exposure.

559 Should oral exposure in Hypoaspis aculeifer tests be considered in order to keep them in Tier I test battery for ecological risk assessment of PPPs? T. Natal-da-Luz, CFE - Centre for Functional Ecology / Department of Life Sciences; T. Gevaert, CFE Centre for Functional Ecology and Hogeschool Gent, Education, Health and Social Work, University College Ghent; C.S. Pereira, CFE - Centre for Functional Ecology / Department of Life Sciences University of Coimbra; M. Arnljot, EFS, European Food Safety Authority / Pesticides; J. Sousa, University of Coimbra / Department of Life Sciences

The recent scientific opinion of EFSA addressing the state of the science on risk assessment of plant protection products (PPPs) for non-target arthropods highlighted the need for the inclusion of other relevant exposure routes, besides contaminated soil, in tests from lower tiers. The reproduction test with the predatory mite Hypoaspis aculeifer (OECD 226) is currently being included in the new EU data requirements for the ecological risk assessment (ERA) of PPPs. However, the low sensitivity often shown by this mite towards PPPs, when compared to other invertebrates, makes the test with this species, as it is currently performed, not very useful for tier I test battery. The current test protocol does not take into account the fact that H. aculeifer is a predatory species, and only considers exposure to contaminants via ingestion of contaminated food, directly or indirectly. Therefore, an adaptation of the test performance, by including exposure via contaminated food, is necessary. The methods described in the standard protocol for mite reproduction test advise feeding the test organisms with fresh preys (e.g. cheese mites Tyrophagus putrescentiae) from uncontaminated breeding containers over the test period but, in a real scenario, this exposure is simultaneous for H. aculeifer and their preys. Thus, through this protocol, the toxicity of contaminants to H. aculeifer might be underestimated. The present study aimed to evaluate the importance of oral exposure to the contaminant as an exposure route to be considered in reproduction tests. Two reproduction tests with H. aculeifer were performed (OECD 226) using artificial soil spiked with increasing concentrations of the insecticides endosulfan, methoxychlor, o,p'-dichlorotrichloroethane and 5,126 mg kg⁻¹. Cheese mites were used as food in both tests, but, while in one test cheese mites obtained from normal laboratory breeding cultures (clean preys) were added, in the other test, cheese mites previously exposed to Cu (pre-exposed preys) were used. Results showed that H. aculeifer fed with pre-exposed preys were more sensitive to Cu than mites fed with clean cheese mites. These data support that the route of exposure represents a very important factor,
related to: methodological framework for S-LCA, goal&scope definition (in particular regarding the system boundary definition), data access, and use of qualitative data, methodologies and selection of indicators for the impact assessment phase. The strengths of the methodology are related to its capability of making the assessment of the product more complete, adding its social aspects to the environmental and economic ones, in addition to the increased transparency and traceability of data along the value chain. On the basis of the main challenges for S-LCA identified in this study, recommendations were identified, for future development and implementation of the methodology. The implemented study showed that there is a need for broad improvements of both methodological and communicative issues. To carry out a S-LCA study could be a way to manage social risk thanks to the identification of social hotspots, and to help companies building a targeted strategy for future development of social policies.

563 TBD

564 Social significance analysis of products - considering negative and positive social impacts along the supply chain of leather products

S. Neugebauer, RWTH Aachen University / INAB - Institute for Sustainability in Civil Engineering; M. Traverso, RWTH Aachen

Global textile and especially leather industries facing constant discussions on social compliance mostly in relation to bad working environments and thus cause severe social impacts for different stakeholder groups along the supply chain due to e.g. unhealthy working conditions. In order to determine social impacts occurring during the leather production processes, social life cycle assessment’s (S-LCA) implementation is of major importance. Practical implementations have to consider indicators and impacts determining social hotspots along the supply chain and should in addition provide information on social challenges and chances by means of negative and also positive social impacts. When assessing products’ life cycle the inclusion of positive social impacts is crucial, as most of the S-LCA indicators can be both positive or negative. Thus, this study aims at providing a social significance analysis (SSA) determining social hotspots along the leather supply chain including social impacts considering negative as well as positive consequences. Existing social indicators are included, addressing relevant stakeholder groups and impact pathways, e.g. fair wage. New indicators are defined where needed, e.g. to represent the rights for indigenous people affected. The assessments are performed by means of secondary databases, e.g. Social Hotspot Database, and by including primary data gathered at production sites of the European leather producer. The results will provide the challenges and chances of European leather production including the different stakeholder groups affected (e.g. workers) but also positive/negative directions of each social impact category defined (e.g. fair wage as a positive and negative indicator and utility as a purely positive indicator). The SSA is based on the S-LCA of European leather production using the LCA methodology. Following the keywords and critical topics along the supply chain, e.g. existence of labor laws. Relevant social hotspots are identified. Depending on the indicator direction, social consequences (e.g. benefits in societal health resulting from non-exhausting work hours) can be determined for the stakeholder groups. The inclusion of positive impacts may function as an incentive for improvement and guide the way towards future developments within the European leather industry. The results may also be transferred to further product groups in the global textile and leather industry.

565 Integration of sustainability in industrial research and innovation: perspectives from ArcelorMittal's experience

A. Hettinger, M. Caraty, R. Turconi, ArcelorMittal / Sustainability RD; P. Cortijo, Utopies

The iron and steel industry is both a key material for society's development, being used in a wide range of market sectors such as infrastructure, transport, construction and packaging. Because of its utility and complex supply chain, to promote sustainable development it is essential to ensure efficient production processes, optimizing the use of resources, valorization of byproducts, but also to explore the other stages of lifecycle of products that use steel, i.e. to adopt the holistic approach of Life Cycle Assessment. Lifecycle thinking enables ArcelorMittal - the world’s largest steel producer - to promote sustainability not only in its own operations but also in the use of its products by customers. For more than a decade, a research team dedicated to sustainability and lifecycle assessment has been supporting the process and product research within the group. However, with more than 1,000 researchers in 12 research centers globally and hundreds of projects carried out every year, it is impossible for a single team to cover systematically the research performed. To this goal, the “Sustainable Innovation Tool” has been developed to enable the researchers of the group to self-assess their projects sustainability. Using the tool, they evaluate environmental and social aspects of their new processes and products and engage in a learning curve for an improved sustainable performance. The presentation will describe the collaborative development of the tool, the different phases of testing and the current start of the deployment across 6 research programs. We will draw on this experience to provide elements that supported its success, pitfalls to avoid. The company is at the start of this journey and seeks a continuous progress, and possible paths for a better integration between our current assessment of industrial research and generic frameworks such as the sustainable development goals will be discussed.

566 Social footprint of a packaging waste deposit-refund system in Spain

L. Musco, 2.0 LCA consultants; B. Weidema, Aalborg University; A. Bula, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change. Escola Superior de Comerç Internacional ESCI; P. Fullana, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle, and Climate Change, Escola Superior de Comerç Internacional ESCI

We present a social footprint assessment of implementing a deposit-refund system (DRS) applied to beverage packaging waste in Spain. In a DRS consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. The social footprint developed by Weidema et al. (2014) is an example of how to sum up social costs in in/on income redistribution and the sum of all productivity-reducing externalities related to an activity. It is calculated by a top-down approach using input-output data. This method can be understood as a ‘streamlined’ social LCA. We applied its two general components: the income redistribution impact (IR): the increase (or loss, if negative) in utility caused by the transfer of money from one societal group to another, and the productivity impact (loss) from missing governance (PG): the difference between the actual purchasing-power corrected value added and the potential value added when all productivity impacts are internalised. The social footprint of an activity can be defined as SF = IR + PL. We compared two scenarios, namely the current situation for household packaging waste in Spain in 2014 (system A), and a hypothetical scenario (system B) where a DRS is implemented. The functional unit is the total amount of packaging waste to be managed annually. Primary data for the two scenarios were obtained from the environmental and economic studies performed as part of this project. Data to quantify the social footprint were obtained from the database EXiobase v.3.3.10, which was implemented in the software SimaPro. The results show that the social footprint for both systems involves a net social benefit. However system B reduces this benefit by 50% compared to system A. Introducing this DRS system in Spain is expected to lead to a net loss in social benefit compared to the existing system. The social benefit of the increased recycling is more than outweighed by the social costs induced by the activities required to achieve these higher recycling rates (collection manually or automatically of packaging waste in shops and supermarkets and the related transportation). The social footprint together with a powerful tool like EXiobase, can pave the way for an operational approach to social LCA, avoiding excessive data requirements and the long lists of impact indicators currently proposed for bottom-up approaches.

567 Poster spotlight: TH226, TH227, TH228

Developments in the use of bioassays for chemical and environmental risk assessment (I)

568 Application of Equilibrium and Toxicokinetic Models to Understand the Behaviour of Organic Chemicals in In Vitro Toxicity Tests

J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Toxicology testing in the 21st century is expected to rely increasingly on in vitro assays, which now cover a wide range of endpoints including cytotoxicity, receptor binding, protein interactions and DNA binding. In most cases, dose-response relationships from in vitro toxicity tests are reported using nominal concentrations in the test medium despite the known challenges such data introduce for comparing results across different test conditions and between different chemicals and for quantitative in vitro in vivo extrapolation (QIVIVE). Equilibrium partitioning (EQP) and toxicokinetic (TK) models have been proposed in the literature to address some of these issues. The main limitation of equilibrium partitioning models is that instantaneous distribution is assumed and hence uptake kinetics into cells/tissue, cell growth/division and the potential for degradation in the test system cannot be directly included in the calculations. The main objective of this study was to develop a toxicokinetic model (TK) for simulating the behaviour of organic chemicals in in vitro toxicity tests and compare the results to a previously developed EQP model. The toxicokinetic model was applied to a set of hypothetical metal organics chemicals under different scenarios (e.g., biotransformation (half-life) and then the results compared with a previously developed in vitro mass balance modeling tool based solely on equilibrium partitioning. We also applied the
EQP model to a specific ToxCast assay (ACEA, T47D, 80 hr negative assay; cytotoxicity) to illustrate the value of the modelling approaches for QIVIVE and hazard/risk assessment. For relatively persistent chemicals (or in cells/tissue with limited metabolic competency), the simulated mass distribution using the toxicokinetic model is similar to the equilibrium partitioning model output for test durations greater than 12 h. In such cases, the EQP modeling approach is deemed suitable for predicting the concentration dynamics in the static systems that require reliable toxicity metrics for QIVIVE (e.g., membrane concentrations). Of the 306 chemicals included in the ACEA, T47D, 80hr negative assay simulations, approximately 2/3rds had predicted membrane concentrations in the range expected to result in baseline toxicity (membrane dysfunction/necrosis). Chemicals with predicted membrane concentrations well below the baseline toxicity range may act via a specific mode of action and could therefore be prioritized for further investigation.

569 Experimental exposure assessment in in vitro bioassays for organic acids

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Improved assessment of exposure in in vitro toxicity assays is essential for the application of in vitro data for chemical risk assessment. Equilibrium mass balance models have been developed to convert the reported nominal effect concentrations of organic acids to a mass balance or modelling approach. However, saturation of the medium was observed at high chemical concentrations which concentration levels saturation occurs and if it is required to incorporate it in the models. Here we applied a phase partitioning method to measure binding of organic acids to biological matrices like cell culture media and cell suspensions on the one hand, but also for direct measurement of exposure (i.e., Ce, pH). Because polymers like polydimethylsiloxane that are typically used for solid phase microextraction (SPME) are not suitable for charged chemicals, C18-coated SPME fibres were used in this study, that have been previously reported to have high sorption capacities for charged chemicals. Eight organic acids were chosen for the experiments: diclofenac, 2,4-D, ibuprofen, naproxen, warfarin, thioanchron, and gentamicin. A linear binding into existing exposure models for in vitro bioassays.

570 A versatile and low-cost open source pipetting robot for automation of toxicological and ecotoxicological bioassays

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The contrasting demands of performing bioassays in compliance with regulatory test protocols and the need for practical use of automation is creating a call for automation technology to assist with automated handling and analysis of multwell plates. Such systems are typically highly sophisticated and thus costly. As a consequence, the availability of pipetting robots, liquid handlers, and stacking units in environmental monitoring is generally scarce. As a potential solution, we developed a simple and low-cost, versatile open-source pipetting robot that has a small footprint. The construction of the pipetting robot was realized mostly using readily available parts, and partly using open-source hardware. We tested its precision in automated 2-fold dilution series and used it for exposure of zebrafish embryos (Danio rerio) – a common model species in ecotoxicology - to cadmium (Cd) and permethrin. As expected, concentrations of permethrin rapidly decreased after initiation of static exposures and after each renewal in the semi-static exposure experiments. No such drastic differences were observed for exposures conducted using the pipetting robot. The accuracy of the pipetting steps was generally high. The apparent toxicity was not only greater in zebrafish embryos exposed to permethrin and cadmium using manual semi-static renewal (24 h interval) but also to static exposures. This was further supported by experiments at 4°C and the measurement of cell metabolism. The presence of a chemical sink in the basolateral maintained the concentration gradient and increased the permeation by approx. 1.5 to 3 times, depending on the logKow. At present, there are no comparable intestinal permeation data for fish available, which precludes a direct comparison of the in vitro measured rates with in vivo observation. However, exactly this unavailability of data highlights the importance of the development of such models for understanding and studying the intestinal epithelium. Data derived with this barrier model can help to develop strategies to link in vitro permeation with the prediction of bioaccumulation factors for fish. Moreover, the well-defined exposure scenario in our system comprises a prerequisite for studying mechanisms underlying chemical permeation, such as active transport or biotransformation.

572 A new paradigm in water sampling - how can we challenge the needs of effect-based monitoring?

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In vitro and in vitro bioassays (effect-based methods, EBM) are increasingly used for the water quality monitoring to complement chemical analysis. In a holistic point of view, sampling is the starting point and an integrated part of the whole analysis workflow. However, sampling for effect analysis is more challenging than for chemical analysis. Thus, the aim of this paper is to discuss (1) the requirements and challenges of sampling for EBM and (2) to present the recently developed large-volume solid phase extraction approach and apparatus (LVSPEx) as a
promising technology to overcome the disadvantages of traditional sampling techniques with respect to EBM. The first challenge is the demand of water to be enriched which is dependent from the number and extracts consumption of the bioassays used for the assessment. The second challenge is the recovery and carry-over of the potential toxicity from the water sample to the vessels or wells of the bioassay. The third challenge is the representativeness of the sample. The successful implementation of EBM strategies requires the availability of automated sampling devices which allow the sampling of larger water volumes, guarantee the sampling integrity and makes it possible to take representative samples over a longer period or during events such as heavy-rain- and flood-events. A solution to overcome the disadvantages of classical sampling methods and devices is the recently released LVSPPE approach and apparatus. It brings the SPE onshore, allows full control of the sample processing and avoids the transport of larger water volumes to laboratory for filtration and extraction. LVSPPE was comprehensively assessed with respect to recovery and carry-over of effects. It has been shown that LVSPPE is applicable in monitoring and survey programs, to assess surface water and wastewater with effect-based tools and to unravel one of the causes of mutagenicity in the river Rhine using effect-directed analysis. Thus, LVSPPE is a promising technology for the implementation of EBM for water quality monitoring in European and worldwide water quality monitoring. LVSPPE is commercially available from MAXX GmbH. However, we declare no conflict of interests as all results presented are scientifically justified.

573 Prioritization of non-target screening suspects based on semi-quantitative concentrations and ToxCast in vitro toxicity data
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In addition to target analyses of chemicals in water samples, non-target analyses are increasingly being applied. The aim of this study was to develop an innovative prioritization tool for chemicals of emerging concern for drinking water, by combining HRMS data with high throughput toxicity data from EPA’s ToxCast database. To increase the health relevance of the prioritization method, both semi-quantitative concentrations (internal standard equivalents) in the water samples (as a measure of exposure) and toxicity classes based on 5th percentile AC50 values (as a measure of hazard) were included as these form the basis for health risk assessment. A procedure to collect chemical-specific toxicity data from the ToxCast database and a scoring methodology for detected suspects were developed and applied to different types of water samples (sewage treatment plant effluent, surface water, ground water and drinking water) to prioritize suspects for identification and further risk assessment. ToxCast data were collected from the EPA’s online ToxCast data repository. Assay endpoint AC50 values (the concentration at which 50% of the maximum response is achieved) were extracted from the ToxCast database for the tested chemicals (suspects). All ToxCast assays were included in this hypothesis-free analysis. To reduce the impact of very sensitive assay endpoints, the 5th percentile of the range of AC50 values of a suspect chemical in ToxCast assays was used as a measure of its toxicity. More than 7000 structures were detected in these water samples by HRMS non-target screening analyses, and these could be linked to >1000 suspects from a curated suspect list of >5000 EU and water relevant chemicals. The ToxCast database contains in vitro effect data for 549 of the 1073 suspects present in the water samples. Many suspects were prioritized based on toxicity and semi-quantitative exposure levels that were not prioritized earlier based on exceedance of the threshold of Toxicological Concern. After confirmation of their identity, the prioritized suspects are candidates for a in-depth risk assessment based on all available toxicity data, for introduction in monitoring programs or for further risk management measures. Standardization of prioritization schemes for suspect screening approaches may be needed for further introduction of these techniques in water quality regulations. Funded by the Joint Research Program of the Dutch water companies (BTO, project #00554-214).

From detection to action: advancements in assessing and managing highly fluorinated compounds
574 Toward the Comprehensive Profiling of Zwittenion, Cationic, and Anionic Perfluorooalkyl and Polyfluorooalkyl Substances in Firefighting Foam Impacted Soils
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In recent years, the comprehensive analysis of both aqueous film forming foam (AFFF) formulations and environmental samples aided to reveal the identities of novel classes of perfluorooalkyl and polyfluorooalkyl substances (PFASs). Following the prioritization of firefighting activities or fire emergency response, the soil is typically the first environmental compartment impacted. In such samples, newly identified PFASs could surpass the concentrations of legacy PFASs by orders of magnitude, indicating the need for in-depth characterization of their transport potential and effects in ecosystems. The methods currently available for the analysis of perfluoroalkyl acids (such as PFOS or PFOA) could, however, seriously underperform for certain newly-identified PFASs. Severe discrepancies were noted as regards the extraction efficiency of cationic and zwitterionic PFASs between soils of variable textural class and organic matter (OM) content, which could not be compensated through some dilutional correction to the lack of matching internal standards. If consistent and method recovery and accuracy cannot be ensured in a set of environmental samples of variable physicochemical characteristics, any comparison drawn between samples (e.g., inter-site differences) could be questionable. Failure to obtain quantitative recoveries from soils/sediments could also preclude a reliable assessment of environmental fate properties (e.g., AFFF-norized partitioning coefficients, soil/sand/wool biomagnification factor). Given the aforementioned limitations, the present study set out to propose a suitable preparation procedure for the multi-residue analysis of PFASs in AFFF-impacted soils. A total of 89 PFASs, representing >20 distinct chemical classes previously discovered in AFFF formulations or across AFFF-impacted sites, was therefore evaluated. Multiple extraction methods were assessed to recover PFASs from AFFF-impacted soils and 28 industrial textiles have been investigated in-house with AFFFs and aged. The optimized method presented quantitative or near-quantitative PFAS recoveries from diverse soils and limited matrix effects were noted. The method was applied to a limited survey of firefighting training areas in eastern Canada, showing the prevalence of betaine-based (e.g., 6:2 FTAB, 9:1:2 FTB) and amine-based (e.g., PFHxS,PFAS) PFASs at such sites.

575 Investigation of perfluoroalkyl and polyfluoroalkyl substances in products used for building industry as well as industrial textiles and their possible contribution to water contamination
E. Janssens, Hochschule Fresenius, University of Applied Sciences; S. Lebentz, SGIS Institut Fresenius GmbH; T.P. Knapper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology Perfluoroalkyl and polyfluoroalkyl substances (PFASs) have been widely studied in environment, outdoor clothes and fire fighting foams. As a consequence of the hazardous environmental properties of some PFASs, such as persistence, bioaccumulation and toxicity, their fate has been widely discussed. Due to their limited presence in the environment, efforts were made to investigate its origin. A total of 3 samples from products used in building industry and 28 industrial textiles have been investigated in the course of this project. Monitoring covered 29 PFASs with a chain length of C4 to C14, including carboxylic acids, sulfonic acids, sulfonamides and fluorotelomer alcohols. PFASs of diverse chain length (C4-C14) were detected in 31 of 51 investigated samples. Concentrations of perfluoroalkyl acids were up to 430 µg/kg for highly contaminated samples. FTOHs were even detected in concentrations up to several mg/kg. However, FTOHs need to be further investigated since they may be false positives resulting from the low selectivity of utilized transition for TOFH quantification. In addition to performed investigations, rinse of samples of e.g. buildings should be performed to prove suggested entrance pathways. Furthermore, additional method development has to be performed in order to better illustrate entrance pathways.

576 The growing role of seafood consumption for exposures to legacy PFASs
Evident in Longitudinal Birth Cohorts from the Faroe Islands
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Rapid declines in legacy poly- and perfluoroalkyl substances (PFASs) have been reported in human populations globally following changes in production since 2000. However, temporal shifts in exposure sources are not well understood and this is particularly important for mitigating exposures through seafood consumption, especially perfluorouracilacnoneacetic acid (PFUuDA, r=0.72). Toxicokinetic modeling revealed PFAS exposures from seafood have become prominent in 2012. Perfluorocarboxylic acids (PFCAs) with nine or more carbons (C≥9) and declined significantly by 14.4% yr⁻¹ in the period 2000–2012. The growing role of seafood consumption for exposures to legacy PFASs was evident in Longitudinal Birth Cohorts from the Faroe Islands. Median SPFAS concentrations in children (ages 5 to 13 years) were noted. The method was applied to a limited survey of firefighting training areas in eastern Canada, showing the prevalence of betaine-based (e.g., 6:2 FTAB, 9:1:2 FTB) and amine-based (e.g., PFHxS,PFAS) PFASs at such sites.
Membrane-water partition coefficients to aid PFAS risk assessment.
S. Droge, University of Amsterdam/IBED Institute / IBED

Widely varying structures of fluorinated compounds have been detected ubiquitously in humans and the environment. Due to the limited understanding of basic physical-chemical properties of any of these PFASs, risk assessment (RA) models still provide highly uncertain outcomes. Most PFASs are ionogenic, and act as surfactants. As a result, octanol-water partition coefficients (K_{ow}) can not be determined experimentally. Due to the lack of experimental data, QSARs to predict K_{ow} are not properly calibrated for any perfluorinated ionogenic compounds. Furthermore, the dissociation constant (pK_{a}) of PFASs has proven to be difficult to determine experimentally and is simply unknown for most emerging alternative PFASs. This may lead to high uncertainty on the fraction of ionized and neutral species at a certain environmental pH of emerging PFASs, and the link to the chemical’s “hydrophobicity”. One of the main applications of a K_{ow} value in RA models is to relate a chemical’s “hydrophobicity” to bioaccumulation and toxicity. It is therefore utmost surprising that hardly any data is available on measurements of sorption data to (phospho)lipid, for which assays are readily available and that lack all the concerns about experiments with octanol. Phospholipids are in general the key tissue component to sorbs ionogenic surfactants, and relate directly to baseline toxicity levels and bioaccumulation. The current study evaluates the results of two experimental tools to measure sorption of standard PFAS structures to artificial phospholipids: retention on immobilized phospholipid chromatographic column and solid supported lipid membranes. The current study also evaluated to what extent quantum-chemical software COSMOtherm, which does not require a partition coefficient, using novel methods. It does take 3D molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning (K_{ow}) of the ionic perfluor species, and the predictions on pK_{a}. Whereas COSMOtherm accurately predicts K_{ow} for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on pK_{a} for some alternative PFASs, e.g. GenX. It appears that negative charged electrostatics exert a great fine-tuning influence on cations of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

578 Impacts of ocean circulation on the marine PFOS burden in an era of geographically shifting emissions
C. Wagner, Harvard University / Harvard John A Paulson School of Engineering and Applied Sciences; C. Thackray, Harvard University / School of Engineering and Applied Sciences; X. Zhang, Wisconsin Department of Natural Resources / Natural Resources and Environment, University of Wisconsin - Madison; C. Van Vault, University of Amsterdam / IBED Institute / IBED

Concerns over the persistence, bioaccumulation potential and toxicity in organisms prompted the inclusion of perfluorooctane sulfonate (PFOS) in the Stockholm Convention in 2001. The ocean is thought to be the terminal sink for most PFOS releases, but it cannot be assumed that simply takes 3D molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning (K_{ow}) of the ionic perfluor species, and the predictions on pK_{a}. Whereas COSMOtherm accurately predicts K_{ow} for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on pK_{a} for some alternative PFASs, e.g. GenX. It appears that negative charged electrostatics exert a great fine-tuning influence on cations of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

579 PFAS pollution at airport sites: point and diffuse sources, fate and transport and remediation
S. Helg, G.D. Breivold, Norwegian Geotechnical Institute
Using Norwegian airports and fjords as case studies this work will present the identification of point and diffuse source PFAS inputs, the environmental behavior (partitioning) of these compounds in relation to their presence in soil, ground water, surface water and biota as well as suitable remediation methods for different sites. The once highly desirable physicochemical properties of PFAS (resistance to heat, water and oil) has led to a large-scale environmental problem as these properties go hand in hand with a low degradative potential, high persistence, high mobility and toxicity. At airport firefighting training facilities aqueous firefighting foams (AFF) containing PFAS have been used in order to practice extinguishing fires. This has led to a point source input of pollution of soils, waters and biota in close proximity to these areas. The use of PFAS containing substances by the textile and paper making industries, as well as their presence in waste sent to landfills represent several diffuse source pollution pathways. The case studies presented encompass all of these inputs, and methods used to monitor the behavior of PFAS in soil, ground water, surface water and biota (including the use of passive samplers) will be discussed. Understanding the partitioning and leaching behavior of these compounds allows more informed regulatory decisions to be made and given that the regulation of PFAS is currently under the spot light this is of great importance. Perfluorohexane sulfonate were recently included on the list of Substances of Very High Concern in REACH. PFOS is included in the water framework directive and an environmental quality standard is often used in order to set clean up targets. The remediation of PFAS impacted sites presents unique challenges and current remediation of water often relies on pump and treat using activated carbon filters to sorb PFAS. There are fewer suitable remediation methods for soils. Through the case studies presented, different remediation methods that are currently being used in the field and lab (pump and treat and sorbent amendment) will be presented. Sorbent amendment has been shown to be a promising approach with reductions of PFAS leaching up to 99 %.

Improvements in environmental exposure assessment:

580 Environmental fate and exposure models: Advances and challenges in 21st century chemical risk assessment
M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; A. Di Guardo, University of Insribia / Department of Science and High Technology; T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; M. MacLeod, Stockholm University / Department of Environmental Science and Analysis; Dr. Y. Song
Environmental fate and exposure models are a powerful means to integrate information on chemicals, their partitioning and degradation behaviour, the environmental scenario and the emissions in order to compile a picture of chemical distribution and fluxes in the multimedia environment. A 1995 pioneering book, resulting from a series of workshops among model developers and users, reported the main advantages and needs for research in the field of multimedia fate models. Considerable efforts were devoted to their improvement in the past 25 years and many aspects were refined: the inclusion of nanomaterials among the modelled substances, the development of models at different spatial and temporal scales, the estimation of chemical properties and emission data, the incorporation of additional environmental media and processes, the integration of sensitivity and uncertainty analysis in the simulations, etc. However, some issues are still challenging and require research efforts and attention: the need of methods to estimate partition coefficients for polar and ionizable chemical in the environment, a better description of bioavailability in different environments as well as the requirement of incorporating more ecological realism in exposure predictions to account for the complexity of ecosystem processes and functions and risk assessment. Most PFASs are ionogenic, and act as surfactants. As a result, octanol-water partition coefficients (K_{ow}) can not be determined experimentally. Due to the lack of experimental data, QSARs to predict K_{ow} are not properly calibrated for any perfluorinated ionogenic compounds. Furthermore, the dissociation constant (pK_{a}) of PFASs has proven to be difficult to determine experimentally and is simply unknown for most emerging alternative PFASs. This may lead to high uncertainty on the fraction of ionized and neutral species at a certain environmental pH of emerging PFASs, and the link to the chemical’s “hydrophobicity”. One of the main applications of a K_{ow} value in RA models is to relate a chemical’s “hydrophobicity” to bioaccumulation and toxicity. It is therefore utmost surprising that hardly any data is available on measurements of sorption data to (phospho)lipid, for which assays are readily available and that lack all the concerns about experiments with octanol. Phospholipids are in general the key tissue component to sorbs ionogenic surfactants, and relate directly to baseline toxicity levels and bioaccumulation. The current study evaluates the results of two experimental tools to measure sorption of standard PFAS structures to artificial phospholipids: retention on immobilized phospholipid chromatographic column and solid supported lipid membranes. The current study also evaluated to what extent quantum-chemical software COSMOtherm, which does not require a partition coefficient, using novel methods. It does take 3D molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning (K_{ow}) of the ionic perfluor species, and the predictions on pK_{a}. Whereas COSMOtherm accurately predicts K_{ow} for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on pK_{a} for some alternative PFASs, e.g. GenX. It appears that negative charged electrostatics exert a great fine-tuning influence on cations of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

581 Development and update of environmental exposure assessment tool EUSES for REACH and BPR Regulations
S. Frattini, ECHA-European Chemicals Agency; R. Cesnaitis, European Chemicals Agency; H. Schimmelflenning, European Chemicals Agency ECHA; H. Magaud, European Chemical Agency ECHA

Introduction Both REACH Regulation and the Biocidal Products Regulation requires that the chemicals addressed by the respective legislations are used safely. Both regulations require environmental exposure and risk assessment of chemicals. EUSES (the European Union System for the Evaluation of Substances) is a tool developed by authorities in the 90’s to support environmental exposure and risk assessment chemicals in line with the methods described in the technical guidance document (TGD 2003) that has treated the assessments practices for these three policy areas at that time. EUSES last relevant update was in 2004, so that the tool is now partly outdated. An update is needed since the availability of an up-to-date tool is critical for both REACH and the BPR to function effectively, both for applicants/registrants, MScAs and ECHA. EUSES has several modules (release exposure and distribution) that have been calibrated for existing alternative compounds and new ones. The focus here is to present the release and distribution module (including interaction with the release scenario) as well as release estimation module are in the focus of the update process.

Update needs and developments The release, fate and distribution modules should be improved based on the development having occurred over the last years, in particular: Implementation of existing and newly developed emission scenario documents (ESD) for biocides in the release module of EUSES. Complementing the release scenarios covered by EUSES, Expanding the applicability domain and exposure
estimation capability of the model. Alignment of the exposure estimation methods to the scientific developments over the last 20 years. Implement the new module of SimpleTreat (4.0). Exploring how to address site specific assessment by EUSES, like for example within autorisation process. A process has been initiated by ECHA with stakeholders to assess the need for update of EUSES. The kick off for this update process is a workshop with stakeholders which will take place in ECHA, in April 2018. The expected outcome of the workshop is the identification and presentation of problem areas and input of potential solutions (scientifically and IT support/setting). Workshop outcomes planned to be available before May 2018 and will be presented to the wider audience of the SETAC conference.

582 Advances in exposure assessment of fertilizers: development of a fertilizers environmental exposure tool and generic exposure scenarios under REACH L. Della Pietra, Fertilizers Europe; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; R. Psuka, Yara Suomi; M. Bjergan, Yara International ASA; K. Oorts, ARCHE Fertilizers are considered as formulations and therefore no registration or chemical safety assessment is required under REACH. However, use of the individual constituents needs to be covered in the chemical safety reports (CSR) of the respective substances. Currently, exposure and risk assessment of fertilizer uses is mainly described in a qualitative way because of the lack of appropriate environmental release categories (ERCs) and exposure models. Under the umbrella of Fertilizer Europe and the FARM REACH consortium, the fertilizers sector has developed a fertilizer sector uses map. In addition, four sector specific ERCs (SPERCs) were developed, by grouping similar uses, mainly based upon their physical form and application mode. Next, a Fertilizers Environmental Exposure tool (FEE) tool was developed, since in the standard REACH models for environmental exposure assessment (EUSES, ECETOC TRA, CHESAR), no local scenarios are defined for direct emission of fertilizers to air. The use of fertilizers has been developed via direct rainfall or agricultural fields to surface water are not taken into account. In addition, important output pathways for fertilizers via crop uptake and harvest are generally not considered in these tools. Quantitative exposure scenarios, resulting in the calculation of realistic worst-case local Predicted Environmental Concentrations (PEC local) for fertilizers in the various environmental compartments (soil, water, sediment) were established. The main focus of the FEE tool is on micronutrients such as manganese, copper and zinc, which are identified as hazardous for the aquatic environment; but the tool allows for assessment of other inorganic and organic substances in fertilizers as well. Conceptually, the tool has been based upon existing REACH exposure modelling, but is adapted for fertilizer uses by adopting different considerations from other chemical legislations. In order to improve harmonization and communication within the supply chain, generic exposure scenarios have been developed for a number of micronutrient and SPERC combinations. Collectively, the development of SPERCs, the fertilizers environmental exposure tool and generic exposure scenarios, allow for a systematic review of environmental exposure assessment of fertilizers into the standard REACH legislation. Further information on the project, including downloads of the FEE tool and SPERC factsheets can be found via www.fertilizerseurope.com.

583 Bioaccessibility of grease thickeners and the implications for REACH regulation R.J. Brown, wca consulting; R. Smith, wca; P. Whitehead, wca consulting; J. Dawick, G. Whale, Shell Health / Risk Science Team; A. Dodos, Eldons; T. Halmans, Shell Global Solutions International / Analytical Department An intrinsic component of greases are the grease thickeners which include a diverse range of substances including metal soaps, metal-complex soaps and polybases. These different thickeners impart different technical properties on the final grease. Although individually registered under REACH as isolated substances, it is proposed that a lack of exposure based on bioaccessibility, is taken into consideration when registering the substances under REACH. This is a pragmatic approach for a group of substances that have low hazard potential and avoids conducting unnecessary vertebrate animal testing. The ERGTC strategy for registering grease thickeners under REACH, taking into consideration bioaccessibility, will be presented, including proposed “limits for leaching”. This approach could be expanded to include other types of similar substances which occur in situ in an inert carrier such as base oil

584 The durability criteria: a pragmatic and sound approach to the exposure assessment of nano-enabled agrochemicals M. McLachlan, University ofVictoria / Department of Environmental Geosciences; P.S. Kookana, CSIRO / Land and Water After many years of research and development, nano-enabled agrochemicals are starting to make their way into the market. Evaluating nano-enabled agrochemicals against conventional analogues is essential to assess the new risks and benefits associated with the technology, and this raises a number of issues for regulators. The ecological risk assessment of nano-enabled agrochemicals is likely to differ from that of conventional products and new parameters are needed to allow an adequate evaluation of the new products. The majority of products currently in development consists in nanocarrier systems loaded with a registered AI. For this type of products, a priority for assessment is to establish the time during which the AI remains associated with the nanocarrier, i.e. the “durability” of the AI–nanocarrier complex (1). Koopmans et al. [2] presented a series of guiding principles for the regulatory evaluation of environmental risk associated with nano-enabled pesticides, including a conceptual strategy relying on the durability parameter. A group drawn from regulatory agencies, academia, research, and the agrochemicals industry recently offered a perspective on relevant considerations pertaining to the problem formulation phase [3]. A case study (pendulinin-mixed insecticide nanosuspension) was used to test and the framework proposed for additional exposure assessment. The scheme serves as a useful base to guide additional requirement and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI–nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI–nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. Kah M, Hofmann T. 2014. Environ. Int. 63:224–235. 2. Kookana RS et al. 2014. J. Agric. Food Chem. 62:4227–4240. 3. Walker GW et al. 2017. J. Agric. Food Chem. doi:10.1021/acs.jafc.7b02373.
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science

586 Regulatory tools and activities for environmental risk assessment of nanomaterials in ECHA

A. Kapanen, European Chemicals Agency - ECHA; L. Deyieder Stephan, European Chemicals Agency / Evaluation Directorate; V. Rodriguez Unamuno, A. Karjalainen, J. Holmquist, European Chemicals Agency ECHA European Chemicals Agency (ECHA) implements the REACH Regulation (EC) No 1907/2006 (Registration, Evaluation and Restriction of Chemicals), the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012), and the Classification, Labelling and Packaging (CLP) Regulation (EC No 1272/2008). Industry and authorities need to fulfill their obligations regarding these regulations also for nanoforms as for any other form of a substance. Nanomaterials are implicitly covered by the substance definition of REACH Regulation 1907/2006 although there are no explicit requirement laying down NM specific obligations. ECHA’s experience has shown that REACH would benefit from nano-specific provisions. The BPR has partly implemented the Commission recommendation of 18 October 2011 on the definition of nanomaterials article 3(1)(xi). It states that the approval of an active substance does not cover nanomaterials explicitly mentioned (Article 4). ECHA currently performs three types of activities to implement REACH, CLP and BPR regulations and to support these processes aiming at ensuring safe use of nanomaterials (NM): REGULATE: formal processes under regulatory frameworks, whereby ECHA uses the legal instruments available under REACH (substance dossier evaluation, authorisation and restriction), CLP and BPR; SUPPORT: helpdesk, meetings with stakeholders and with Registrants, Nanomaterials Expert Group (NMEG); COMMUNICATE: ECHA Nanomaterials web-site, conferences, workshops, communication throughout the supply chain and in a broader context e.g. EUON and press. This presentation will provide a summary of the multiple actions taken by ECHA to address NM under REACH, CLP and BPR. Dossier and substance evaluation, NMEG, EUON and ECHA’s involvement at OECD level. Communication is currently considering modifying some of the technical provisions in the REACH Annexes. This would allow more efficient efforts towards safe use of NM and decreased uncertainties in the regulatory processes. In addition, ECHA highlights the need for good coverage of standard methods applicable to NM to produce adequate information for regulatory risk assessment.

587 Building a Risk Assessment Framework for Nanomaterials in Canada

M. Sauve, Environment Canada; A. Shahsavari, Environment and Climate Change Canada

Despite the potential benefits associated with the use of nanomaterials, concerns also exist as to potential environmental and/or human health risks as a result of environmental exposure to nanomaterials. Canada regulates chemical substances, including nanomaterials, under various regulatory mechanisms. The Canadian Environmental Protection Act, 1999 (CEPA) and the Chemical Management Plan (CMP) are key in safeguarding Canadians and the Canadian environment from potentially harmful substances. Under the CMP, the current activities to address nanomaterials include identifying data needs, developing tailored strategies and approaches, work planning and strengthening collaboration with national and international partners and stakeholders. To support these efforts, Canada is developing a science based risk assessment framework (RAF) to guide legislative and regulatory risk assessments of nanomaterials under CEPA. This science based RAF will inevitably touch on many issues faced by other countries and regulators. Our communication strategy includes consultation and collaboration with multidisciplinary experts, the public and stakeholders. Online collaboration tools will be used to encourage participation. A national expert panel will be consulted in the spring 2018, and SETAC Europe would be the first attempt to reach out to the international scientific community for support. We hope to use this venue to generate new partnerships and to strengthen existing ones. Critical questions based on the challenges identified by Canada over more than a decade of regulating new nanomaterials, and by the international scientific community looking at risk assessment challenges for nanomaterials, will be highlighted in this presentation.

588 Inventory of available tools, methods, approaches and best practices on nanomaterials/nanotechnologies

B. Duuren-Stuurman, TNO, Utrechtseweg 48, 3704 HE Zeist, The Netherlands; s. manzo, ENEA / SSPT-PROTER-BS; S. Scalbi, ENEA / UTVALAMB- Technical Unit Model, Methods and Technologies for the Environmental A. P. Reale, ENEA; H. Witters, VITO / Applied Bio & molecular Systems; A. DuscheI, PLUS; H. Stockmann-Juvala, FIOH; T. Bereznjak, NRC-W, A. Fornara, SP.

The EC4SafeNano initiative, founded by Horizon 2020 is an ongoing effort to build a European Centre for Risk Management and Safe Innovation in Nanomaterials and Nanotechnologies. EC4SafeNano aims to bridge the gap between scientific knowledge on hazard and risk, and ‘fit-for-purpose’ risk management tools and strategies supported by measurement and control methods. The Centre of European organisations will offer services for Risk Management and Safe Innovation for Nanomaterials & Nanotechnologies. One of the first actions of the project was developed an inventory of available resources related to nanosafety issues. Indeed, until now, many tools and studies which aim to improve human and environmental nanosafety have been developed by research organizations and EU funded projects. Therefore this inventory have the aim to give a useful overview on tools, methods, trainings, standards, standard operating procedures (SOPs), guidance documents and best practices in nanosafety. quality criteria are included to give users the possibility to select on the basis of examples and exemplars. This inventory will be updated and validated of the resource or the acceptance of the resource in view of the REACH legislation. During and the application of the project this overview will be updated when new information or updated versions of resources become available or when new resources are introduced by a mechanism later to be defined. Moreover this inventory will be published on the EC4SafeNano website. There is a large number of Standards (77) and SOPs (136) that can help the end user to conduct testing on toxicity and eco-toxicity, or measurements in workplaces and environment. One important issue is the scarce number of trainings available only 5. This aspect will be addressed in the EC4SafeNano project to identify the specific training needs and that can be useful to promote the understanding of environmental risks and the amount of information related to the environmental assessment of nanomaterials and nanotechnology is very low. This aspect is covered in only 6 out of the 28 included tools, and 4 out of 43 Guidance and Best practices. This shows that, at the moment, aspects such as eco-toxicity and methodologies for the environmental risk assessment and life cycle assessment have most likely not been deeply investigated

589 The Application of Ecotoxicological Tools to Safer-by-Design Strategies for Engineered Nanomaterials

A. Barrick, Association Saint Yves / UCO / UBL, Mer molécules et santé; N. Minocha, Pardand, INERIS / Expertise and assay in ecotoxicology unit; A. Chatel, Catholic University of the West / UBL, Mer Molécules Santé; C. Mouneyrac, Université Catholique de l’Ouest / UBL, Mer molécules et santé; N. Leconter, ENEA / UTVALAMB

At the end of the research project NanoReg, the aim of this study was to demonstrate the possibility to select or search for resources based on, for example, the organization behind it, their expertise, their methodology or their recommendation of 18 October 2011 on the definition of nanomaterials (Article 4). ECHA currently has a large number of resources. This experience has shown that ECHA would benefit from nano-specific regulations. The BPR has partly implemented the Commission recommendation of 18 October 2011 on the definition of nanomaterials article 3(1)(xi). It states that the approval of an active substance does not cover nanomaterials explicitly mentioned (Article 4). ECHA is currently considering modifying some of the technical provisions in the REACH Annexes. This would allow more efficient efforts towards safe use of NM and decreased uncertainties in the regulatory processes. In addition, ECHA highlights the need for good coverage of standard methods applicable to NM to produce adequate information for regulatory risk assessment.

590 Minimising the risk posed by TiO2 nanomaterials used in sunscreen throughout the entire product lifecycle

D. Chauvin, R. Catalano, A. Barrick, ENEA / UTVALAMB - Marseille Université; J. Hubaud, Holosystème; V. Bartolomei, S. Motellier, CEA Liten; D. Boutry, CEA - Grenoble; L. Hedouin, CNRS CRIOBEO; C. Santella, CNRS/CEA/Aix-Marseille University / Bioscience and biotechnology Institute of Aix Marseille; P. Hennebert, INERIS; A. Pusino, IBIM CNR Palermo; S. Lehmann, University of Grenoble Alps; L. Labille, CNRS Sunscreens are of emerging concern regarding both human and environmental health. While TiO2 nanoparticles used as UV-blockers may offer a safer alternative to organic filters, their fate and impact and resulting regulation are still under consideration, largely related to the potential risk of nanotechnology-based products. After leaving the skin either through bathing or cleaning, the TiO2...
nanomaterials contained in the suncreen can be released into rivers, lakes, sea shores, and/or sewage treatment plants. Their fate and impact in these different systems is largely determined by the surface properties, i.e. the coating type and lifetime. This project aims to develop the eco-design of sunscreens through the minimization of risks associated with nanomaterials incorporated into the formulation. All stages of the cream life cycle must be considered in this light, from its manufacture to its end of life, through its use by the consumer and its impact on the environment. By considering each development stage of the sunscreen, from the choice of UV-blocker and its integration into a cosmetic formulation, to the knowledge of the risk involved in this choice all along the product lifecycle, an eco-design approach can be achieved and risk can be minimized. The present work combines industrial companies specialising in cosmetic formulation with academic research experts in the fields of exposure, toxicity and lifecycle assessment. Sunscreen fabrication, risk for the consumer by dermral exposure, risk for the direct aquatic environment and risk related to the end of life of the product are as many key steps of the sunscreen lifecycle that were investigated in this project.

591 Environmental risk assessment of engineered nano-SiO2, nano iron oxides, nano-CeO2, nano-Al2O3, and quantum dots B. Nowack, EMPA; Y. Wang, Empa Swiss Federal Laboratories for Materials Science and Technology

Many research studies have aimed to investigate the ecotoxicological hazards of engineered nanomaterials (ENMs). However, little is known regarding the actual environmental risks of ENMs, combining both hazard and exposure data. The aim of this study is to quantify the environmental risks for nano-Al2O3, nano-SiO2, nano iron oxides, nano-CeO2, and quantum dots by comparing the predicted environmental concentrations (PEC) with the predicted no effect concentrations (PNEC). The PEC values of these five ENMs in fresh waters in 2020 for northern Europe and southeastern Europe were taken from a published dynamic probabilistic material flow analysis model. PNEC values were calculated using probabilistic species sensitivity distribution (PSSD). The order of the PNEC values was quantum dots < nano-CeO2 < nano iron oxides < nano-Al2O3 < nano-SiO2. The risks posed by these five ENMs were demonstrated to be in the reverse order: nano-Al2O3 > nano-SiO2 > nano iron oxides > nano-CeO2 > quantum dots. However, all risk characterization values are four to eight orders of magnitude lower than one and no risk was therefore predicted for any of the investigated ENMs at the estimated release level in 2020. Compared to static models, the dynamic material flow model allowed us to use PEC values based on a more complex parameterisation, considering a dynamic input over time and time-dependent release of ENMs. The PSSD approach makes it possible to include all available data to estimate hazards of ENMs by considering the whole range of variability between studies and material types. The risk assessment approach is therefore able to handle the uncertainty and variability associated with the collected data. The results of the current study are able to provide a scientific foundation for risk-based regulatory decisions of the investigated ENMs.

592 Occurrence of cyanotoxins in Greek lakes A. Hiskia, UMR CNRS EcoBio; M. Bormans, UMR CNRS EcoBio / UMR EcoBio; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Phycotoxines / Unité DYNECO / Dept. ODE; C. Wiegand, Université de Rennes 1 / UMR CNRS ECOBIO

Thanks to their adaptation cyanobacteria colonized lacustrine, marine and terrestrial environment. Eutrophication of waters has promoted and will increase cyanobacteria blooms in future, posing hazards to the aquatic ecosystem and human health due to the capability of cyanobacteria to produce bioactive or toxic compounds. One of the groups firstly affected by cyanobacteria is planktivorous zooplankton, such as Daphnia. On the other hand, Daphnia can also suppress cyanobacterial population up to certain density and toxicity. A development of tolerance apparently enables them to withstand cyanobacterial compounds, and is transferable to the next generation. The role of cyanobacterial toxins and other bioactive compounds has not yet fully been elucidated, neither the presence of zooplankton grazers could modify their production. This study investigates the mutual two-way interactions, in terms of biochemical and life trait responses of both, cyanobacteria and daphnia. Microcystis aeruginosa PCC7806 and Lyngbya aestuarii PCC7530 were used for Toxic Compounds in the Environment, Faculty of Science, RECETOX Research Centre for Toxic Compounds in the Environment.

593 Interactions between cyanobacteria and daphnia G. Bojadzija, UMR CNRS EcoBio; M. Bormans, UMR CNRS EcoBio

594 Teratogenic retinoid-like compounds produced by cyanobacteria into surface waters K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX, E. Sychrova, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment, M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; A. Jonas, Masaryk University, RECETOX / Faculty of Science; J. Priebojová, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment RECETOX; J. Veerckova, Masaryk University, Faculty of Science, RECETOX; L. Sehnal, Masaryk University Faculty of Science RECETOX / RECETOX Research Centre for toxic compounds in the environment; T. Procházka, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / RECETOX, reacted to spent medium from D. magna cultures of two weeks: During the first days there was an increase of growth rates, followed by a decrease in physiological performance. Moreover, the antioxidant response increased, which, even though not significant itself, caused a significant reduction in the hydrogenperoxide content in the cyanobacteria. First results indicate that cyanobacteria not only harm aquatic organisms, but that vice versa they react to the presence of potential grazers, hence yet unknown substances present in the spent media impair their performance.
developmental effects in zebrafish (Danio rerio) and frog (Xenopus laevis) embryos. Both the phenotypes and effective concentrations of exudates corresponded to all-trans retinoic acid (ATRA) equivalents, supporting the hypothesis that the teratogenic effects of cyanobacterial exudates are likely to be associated with retinoid-like activity. Non-target analyses and comparison of the spectra of compounds present in exudates with different retinoid-like activities pointed to structural features of compounds contributing to the retinoid-like activity. In the approach of a “virtual EDA” we have characterized in detail retinoid-like activity of 53 samples of exudates from 4 algal species and 15 cyanobacteria species/strains. Only several species of cyanobacteria showed detectable activity, while there was no activity in any algal exudates. We have identified a set of compounds that contribute to the total retinoid-like activity in both laboratory and field samples, including ATRA, 9/13cis retinoic acid, but also several novel cyanobacterial metabolites, such as 5,6epoxy-RA or 4keto-ATRA with high retinoid-like potency. In general, retinoid-like activity has been shown to be associated with cyanobacterial water blooms dominated by many different species, which documents that production of retinoids by cyanobacteria in the environment is a common phenomenon. This study was supported by the Czech Science Foundation project No.18-15199S and FP7 SOLUTIONS project No. 603437.

595 (Co-)Production Dynamics of Cyanobacterial Peptides
R. Sanches Natumi, E. Vonyvi, Eawag Swiss federal Institute of Aquatic Science and Technology / Department for Environmental Chemistry; E.M. Janssen, Eawag Swiss federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry
Cyanobacterial algal blooms are expanding temporally and spatially, which is promoted by eutrophication and likely climate change. Cyanobacteria can produce a wide range of bioactive compounds with different modes of action, including a variety of toxic peptides. Information on formation and degradation of cyanobacterial research production dynamics of the majority of novel cyanopeptides is mostly unknown even for common cyanobacterial strains. Such information is crucial to assess the risk of these emerging natural toxins for human health in evaluating their potential to reach drinking water supply plants. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides other than microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides from common cyanobacterial species including Microcystis aeruginosa and Anabaena flos-aquae strains. Batch culturing was done under varied environmental conditions and the cell abundance was followed by optical density, cell count, and biomass weight. Simultaneously, the cyanopeptide production was followed. Therefore, biomass extracts were purified and measured by liquid chromatography, high resolution mass spectrometry with refined analytical protocols. Comprehensive data analysis was performed to identify cyanopeptides and follow their abundance. These new insights of co-production dynamics are critical to better understand which peptides and peptide mixtures are present during cyanobacterial bloom events.

596 Development of methods for Measuring Total Microcystins in Fish Tissue using the 2-methoxy-3-methyl-4-phenylbutyric acid (MMPB) procedure.
There are limited methods for the analyses of multiple algal toxins in aquatic food webs, phytoplankton, zooplankton, periphyton, macroinvertebrates, forage fish, bottom feeders and top carnivore fish. Algal toxins in freshwater systems do not necessarily occur as single contaminants; mixtures of toxins may be produced by Cyanobacteria, Prymnesium parvum (Prymnesins), and Euglena sanguinea, including microcystins, saxitoxins, cylindrospermopsin, anatoxin-a, prymnesins and euglenophycin. The objective of the first phase of this research was to spike eelgrass leaves and cell cultures in the algal medium, with 3 concentrations of microcystins (LR, LA and RR) individually and as mixtures, and to develop a method for their recovery and measurement using the MMPB derivatization method. The second phase of the project is to field-test this method on fish collected from water bodies experiencing algal blooms and compare results with individual congener measurements. Extraction methods and analytical methods being developed for this phase of the project is to field.

597 Saponins in the aquatic environment: hydrolisis and toxicity
X. Jiang, University of Copenhagen; H. Hansen, University of Copenhagen / Institute of Plant and Environmental Sciences; B. W. Strobel, University of Copenhagen / Plant and Environmental Sciences; N. Cedercreuz, University of Copenhagen / Department of Plant and Environmental Sciences
Saponins are a class of bioactive natural compounds. Due to their detergent-like structure, saponins have a lot of applications, e.g. as biopesticides in crop protection. They may lead into the aquatic environment due to their low-octanol/water partition coefficient and poor binding to organic matter. They may therefore pose a risk to the aquatic organisms. However, their fate and toxicity in the environment are not fully understood. Hence, we aim to investigate the pH and temperature dependence of saponins hydrolisis together with their dissipation in sampled lake waters and to determine the aquatic toxicity of saponins from quillaja bark, tea seed coat, and quinoa seed coat towards different aquatic organisms. The hydrolysis of saponin (quillaja saponin) showed to be a highly pH dependent base-catalyzed reaction. The half-life was around 330 ±220 days at pH 5.1 and 26°, while decreased to 0.06 ±0.01 at pH 10.0. The hydrolysis was also influenced by temperature with an activation energy of 56.9±14.2 kJ/mol at pH 7.2. Lake waters with pH varying between 6.4 and 8.2 showed completely different hydrolysis patterns, with a fast initial dissipation of up to 60% of the initial saponin concentration, followed by an extremely slow to nil reaction, making saponin partially persistent in lake waters. The maximal concentrations protecting 95% of the aquatic species (HC) derived from the SSD’s of saponins from quillaja bark, tea seed coat, and quinoa seed coat were 2.91 ±0.01, 0.22 ±0.11 and 22.9 ±5.84 mg/L, respectively. The 100-fold difference in toxicity between the saponin-rich extracts from different plant species indicate that saponin toxicity depends on the species where it origins from, making “read-across” between saponins a dubious exercise. In addition, the predicted environmental concentrations of different saponins are close to or higher than their water quality standard, which means that the saponins might pose a risk to the aquatic environment if not used cautiously. Therefore, we recommend not using surrogate or expected data/conclusion in the regulation of saponin-rich plant extracts and pay more attention to the potential risk of saponins to the aquatic environment.

Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach
C. LaLong, U.S. EPA / Mid Continent Ecology Division; G.T. Ankley, U.S. EPA / National Health and Environmental Effects Research Laboratory; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; D. Knapen, University of Antwerp / Zebrasfilhab Dept Veterinary Sciences; S. Munn, European Commission; E.J. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory; M. Rudd, University of York; E. Vonwyl, Eawag Swiss federal Institute of Aquatic Science and Tecnology; M. Whelan, University of leicester / Geography; C. Willett, the Humane Society of the United States / Animal Research Issues; X. Zhang, Nanjing University / Environmental Science; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre: Recognizing the international interest surrounding the adverse outcome pathway framework, which captures existing information describing causal linkages between a molecular initiating event through levels of biological organization to an adverse outcome of regulatory significance, an effort was undertaken to provide the scientific community the opportunity to engage in determining the direction of the AOP framework. Specifically, a horizon scanning effort was used to solicit questions from the international scientific community asking participants to propose questions that consider key outstanding challenges and/or limitations that must be overcome to advance the AOP framework for both research and regulatory decision making. From March-June, 2016, 340 valid questions were collected from 158 global submissions, spanning all continents, to an online horizon scanning survey. Respondents to the survey self identified as 35% academia, 35% government, 20% industry, 5% NGOs, 3% regulatory, 4% non-governmental, and is consistent even with very polar or hydrophobic MCs.
their applications; regulatory use of the AOP framework, and expanding awareness of, involvement in; and acceptance of AOPs to support aspects of predictive toxicology and regulatory decision-making. Charge questions for each workgroup were directly modified from those submitted during horizon scanning. Additionally, from the horizon scanning exercise, frequently asked questions (FAQs) were identified and addressed by experts in the field. Together the horizon scanning and expert elicitation exercise, and resulting FAQs are used to set the stage for the SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway Concept: An International Horizon Scanning Approach,” that took place in Cornwall, Canada during April 2017. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

599 Adverse Outcome Pathway networks: development, analytics and applications


Adverse outcome pathways (AOPs) are an important framework that can help support more effective use of mechanistic, pathway-based, data in risk assessment and regulatory decision-making. AOPs have rapidly evolved from a conceptual paradigm into a formalized framework for organizing biological and toxicological knowledge across the spectrum of chemicals and generally by classes. In response to the recognized need to continue advancing the framework, SETAC sponsored a global horizon scanning exercise to identify major outstanding topics and challenges related to the AOP framework and its application. The development of guidance related to AOP network development and analysis was identified as a critical need. In this presentation, expert elicited exercise, and answers to FAQs on AOP networks, but also on related topics such as mixture toxicity assessment and the implementation of feedback loops within the AOP framework. This presentation briefly outlines critical concepts concerning the development of AOP networks, how they may be analyzed, and illustrates how information derived from them can be applied. First, derivation of AOP networks is considered in the context of how it differs from traditional mechanistic assessment. Next, the application of filters and layers is discussed, which can be used to refine and enrich derived AOP networks so that they may be tailored to address specific questions of interest. We then introduce a number of analytical and computational approaches that may be used to characterize and analyze the structure of AOP networks to derive information that can guide research and regulatory decision-making. A number of application case studies is used to illustrate concepts underlying development and analysis of AOP networks, and how these concepts tie in with ultimate application. The contents of this presentation represent the personal opinions of the authors and neither constitute, nor necessarily reflect the policies or viewpoints of their employers or institutes.

600 Building and Applying Quantitative Adverse Outcome Pathway Models for Chemical Hazard and Risk Assessment

S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; R. Ashauer, University of York / Environment; R. Conolly, US EPA RTP; B. Landsemann, JRC; European Commission; C. Mackay, Unilever; C. Murphy, Michigan State University / Department of Fisheries and Wildlife; N. Pollesch, US EPA / ORD NHEERL Mid Continent Ecology Division; J. Wheeler, Dow Agrosciences; A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; E.J. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory Quantification and Assessment of Indirect AOPs. Next, the application of environmental health is important in understanding the potential hazards and risks of using, or being exposed to, chemicals. Here we examine how the Adverse Outcome Pathway (AOP) concept and knowledge base can be used to develop quantitative models (qAOPs) to predict and assess hazards and risks of chemicals. Quantitative models can be developed with a clear problem definition and using AOPs as initial data sources. Models range from semi-quantitative to quantitative modeling approaches or combination of these (e.g. fully mechanistic mathematical /ordinary differential equation based, individual-based models, statistical, or Bayesian network models). We discuss best practices for choosing modeling approaches, model building and the necessity for transparent and comprehensive documentation in order to gain confidence in the use of a model. Finally, we present examples of how qAOP models can support decision making: a screening level assessment of the health hazards of chemicals and chemical mixtures using a qAOP Bayesian network model of stoatosis, the use of qAOPs in a prospective risk assessment context (e.g. in vitro to in vivo extrapolation using aromatase inhibition as an example) and for extrapolation between species or life stages.

601 Use of Adverse Outcome Pathways to Inform Decisions on Chemical Innovation, Regulation & Stewardship

T. Hill, US EPA NHEERL Integrated System Toxicology Division; P. Browne, OECD / OSCP; K.K. Coady, The Dow Chemical Company / Toxicology Environmental Research and Consulting; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); T. Hutchinson, School of Biological Sciences, Plymouth University / School of Biological Sciences; E. Lienala, OECD; L. Maslankiewicz, National Institute for Public Health and the Environment (RIVM); T.M. Steeger, U.S. EPA / Office of Chemical Safety and Pollution Prevention

An invited group of scientists participated in a SETAC Pellston Workshop titled “Advancing the Adverse Outcome Pathway (AOP) Concept – An International Horizon Scanning Approach,” in April 2017. The workshop addressed key challenges or limitations of AOP constructs as tools for informing research and regulatory decisions that were identified by responses to a global Horizon Scanning survey. This presentation will summarize the findings of Pellston Workshop 3, which was tasked with the execution of practical considerations for this use of AOP constructs in regulatory decision making. The use of AOPs and related concepts have increased in scientific and regulatory sectors over the past decade, coinciding with pressures to find innovative solutions to evaluate chemical safety in a more efficient and effective manner that better directs resource utilization. This workshop focused on how AOPs can be a useful tool for chemical decision makers in the government and private sector. At the various points where chemical decision making is employed across the “life” of a chemical – from research and development within the commercial sector, government registration and regulation, through to post-marketing use/stewardship – AOPs can be used as an organizing principle. Pragmatic evidence is provided for how AOPs can be and are currently being used in chemical decision-making processes. Considerations for evaluating the suitability of AOP for decision makers are discussed, recognizing that the acceptable level of uncertainty varies based upon the nature of the decision and the context in which it is being applied. The presentation provides multiple examples of AOP use and practical considerations for evaluating whether use of AOPs is fit-for-purpose in different circumstances. This abstract does not necessarily represent the views or policies of the U.S. EPA.

602 Ensuring Long-Term Utility of the AOP Framework and Knowledge for Stakeholders

G.T. Ankley, U.S. EPA / National Health and Environmental Effects Research Laboratory; A. Carusi, University of Sheffield; H. Davies, WA State Dept of Health / Dept of Ecology; G. De Grandis, Norwegian University of Science and Technology; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; G. Hodges, Unilever Research / Safety and Environmental Affairs Research Centre; K. Leeing, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; M. Whelan, University of leicester / Geography; C. Willett, the Humane Society of the United States / Animal Research Issues

The adverse outcome pathway (AOP) framework serves as a knowledge assembly and communication tool to facilitate translation of mechanistic (e.g., molecular, biochemical, histological) data into adverse apical outcomes meaningful to chemical risk assessment. Although initially designed for ecotoxicology applications, the framework has also received extensive attention relative to chemical safety assessments for human health. Moreover, as the AOP concept and associated knowledgebases have evolved, it has become recognized that the potential stakeholder community is broader than scientists and regulators directly involved in chemical safety assessment. For example, the application of AOP-based thinking for addressing biomedical challenges has become increasingly evident. This presentation will identify various stakeholders who currently, or could potentially, benefit from application of the AOP framework and knowledge to specific needs, and describes challenges and strategies to effectively engaging these stakeholders. We also present a “roadmap” on how to maintain a viable, sustainable network to support AOP stakeholders, including recommendations for governance and coordination of AOP development and knowledge dissemination in a multi-stakeholder consortium. The contents of this abstract neither constitute, nor necessarily reflect, official USEPA policy.

603 Adverse Outcome Pathways: Moving from a scientific concept to a globally accepted framework

M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; C. LaLone, U.S. EPA / Mid Continent Ecology Division

The adverse outcome pathway (AOP) framework has gained significant international traction as a systematic approach for capturing existing knowledge to transparently link mechanistic data to apical toxicity endpoints as a means to inform research and risk assessment. While the framework has evolved significantly since
Its introduction in 2010, it was recognized that a survey of the broader scientific community would be useful in identifying shortcomings and in guiding future initiatives. In 2016, we reached out to national and international scientific and regulatory communities to collect questions and provide an opportunity to discuss key outstanding challenges that must be addressed in order to realize the full potential of the AOP framework. Four key themes emerged from this “Horizon Environment” exercise (see presentation “Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach” in this session), which were then addressed at a Society of Environmental Toxicology & Chemistry (SETAC) Pellston™ Workshop comprised of international participants representing industry, government, academia, and NGOs was held in Cornwall, Ontario, in April 2017. This presentation will provide an overview of the overall outcomes and common themes that emerged during this Pellston Workshop. In brief, common themes that spanned across these main topics included the need to simplify, translate, and better communicate the AOP framework to the broader international stakeholder community, and a consensus that the AOP framework does not represent a rigid tool but rather a knowledge repository for diverse stakeholders ranging from epidemiologists to mainstream experimental toxicologist to risk assessors and managers. Furthermore, when considering the AOP framework and its applications, the field of environmental toxicology and human health naturally merged into a continuum that is at the nexus of Toxicology in the 21st century. In particular, it was felt that the current momentum the AOP framework has gained across a wide range of professional sectors provides the unique window of opportunity to reach out to and gain acceptance of this framework by society, which will be required for it to become an integral part of the international chemical and environmental risk assessment landscape. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

Environmental specimen banks in research and regulation for a better environmental quality

604 Monitoring of POPs in the Swedish aquatic ecosystem and in human milk

E. Nyberg, A. Bignert, S. Danielsson, Swedish Museum of Natural History; C. Ek, Department of Applied Environmental Science / Department of applied environmental science.

In the 1960s, the Baltic Sea was found to be severely polluted by persistent organic pollutants (POPs). These discoveries were the starting point of a continuous Swedish national monitoring program for contaminants in biological matrices, mainly from the marine and freshwater environment, with samples dated as far back in time as 1969. Today’s marine and freshwater monitoring programs consist of 32 lakes and 28 marine sites where matrices as perch, pike, arctic char, herring, cod, eelpout, blue mussel and egg from guillemot, oystercatcher and common tern are annually collected. In 1967, examination of human exposure to POPs was initiated by Karolinska Institutet in Stockholm through measurements in human milk from the area, and since 2007 milk has also been collected from Gothenburg in the southwest of Sweden. The milk samples were in 1997 transferred to the Environmental Specimen Bank at the Swedish Museum of Natural History. The main objectives of the monitoring program are to investigate changes over time, to estimate geographical differences and to assess compliances with set target values. Moreover, the program is designed to answer these different questions with a high statistical power. Since the start of the monitoring, concentrations of PCBs, DDT’s, HCHs and HCB have decreased in fish and bird eggs from both the Baltic Sea and the Swedish freshwater environment. Several of the classical POPs have also decreased considerably in human milk. However, the non-linear trends differ between the monitoring matrices for several contaminants. In some cases the peak differs, and in others, concentration is levelling out for one matrix but continues to decrease for another. In addition, the concentrations of PCBs, DDT’s and HCHs are, despite continuous decreases since the 1970’s, still higher in the Baltic Sea compared to, for example, the North Sea.

605 Jumping out of the frying pan and into the fire? Spatial and temporal trends for PBDE, Dechlorane Plus and alternative flame retardants in samples of the German environmental specimen bank


In the last century, conventional brominated flame retardants (FRs) such as polybrominated diphenyl ethers (PBDEs) were identified as persistent organic pollutants and subsequently regulated. Novel or alternative FRs were introduced as their replacements to meet ongoing market demands. Many of these alternative FRs are also highly chlorinated or brominated and their fate and effects in the environment may be similar to those of their regulated counterparts. Until now there are only few comprehensive data sets about alternative FRs in the environment, particularly for Germany. In order to provide for a systematic overview about the current state of contamination of the German environment to FRs, a large set of terrestrial, freshwater and marine samples from the German environmental specimen bank were analysed for 45 FRs (PBDEs, Dechlorane Plus and brominated aromatics, brominated ethers, cyclic BFRs). The substances will be discussed with respect to their spatial occurrence in the environment (including different matrices as well as land use and ecosystem types), their substance patterns in the environment and accumulation in wildlife. A special section looking back to the 1980s, e.g. from coastal herring gull eggs, freshwater fish, tree leaves and roe deer will be used to illustrate time trends for regulated flame retardants and their substitutes. Recommendations will be given to European and international chemical management.

606 New Uses of Archived Specimens from the U.S.A. NIST Marine Environmental Specimen Bank


The National Institute of Standards and Technology (NIST) has been involved in the long-term archival of biological and environmental specimens for over 40 years. Specimens originally intended for monitoring geographic and temporal trends in emerging contaminants as well as changes in transport and accumulation of legacy contaminants have added value today. Tissue and fluid specimens from marine animals, including mammals, seabirds, sea turtles, bivalves, fish, coral and coral ecosystems, collected through various projects are archived at the Marine Environmental Specimen Bank. A new high-value use of the NIST Marine Environmental Specimen Bank is the production of EMF. The program is designed to answer these different questions with a high estimate of EMF. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-coverage well-scanned genome, and 2) the discovery of using total metatranscriptome as an alternate tool to genetic species identification, have also been conducted and will be discussed.

607 Monitoring of the indoor environment of ESB laboratories with selected target and non-target screening methods

P. Bohlin Nizzetto, Norwegian Institute for Air Research; M. Schlabach, A. Halse, P. Rostkowski, NILU / Norwegian Institute for Air Research

The environmental specimen banks (ESBs) handles and store a wide range of high-quality samples with a main objective to perform retrospective analyses of newly identified contaminants (chemicals of emerging concern, CECs). It is of highest importance that the ESBs contributes to improving the knowledge about the environment and not contaminated during handling and storage. Strict quality assurance (QA) protocols are applied at the individual ESBs, including specially dedicated laboratories, no use of personal-care products, cleaning routines and more. More complicated to control is the indoor air and dust in the laboratories and storage locations. Building materials and indoor objects may contain and further emit or release CECs to the indoor environment. To evaluate trends in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-coverage well-scanned genome, and 2) the discovery of using total metatranscriptome as an alternate tool to genetic species identification, have also been conducted and will be discussed.

608 DNA banking and its relevance for biodiversity research

J. Astrin, Zoological Research Museum Alexander Koenig

Within their genomes, the organisms on our planet contain an immense wealth of information about the diversity of life. These genomics conserve the code to identify organisms, comprehend population structures. etc. Fast progress in molecular technologies dramatically speeds up research on genetic biodiversity and increases the demand for professionally preserved and managed genome-quality samples in many disciplines, e.g. in ecology, conservation biology, etc. Biodiversity biobanks cater specifically to these demands, and in a standardized way. Environmental samples collected periodically by ESBS following defined routines constitute a very valuable source of DNA for biodiversity research, as they keep open a window that allows the parallel, correlative analysis of the chemical and of the species community composition of a given environment over time. Through species
identification via DNA barcoding and high throughput sequencing, such samples can be most helpful in documenting and interpreting environmental change. Accumulated snippets of free DNA in soil or water samples (freshly collected or from ESBS), so-called environmental or eDNA, enable the comprehensive appraisal of species compositions in a multitude of environments. DNA extracted from ESBS samples should be deposited in dedicated DNA banks in order to make this resource available to the scientific community and the fast-evolving DNA analysis methodologies (which may prompt repeated analyses of samples over time, with ever-increasing amounts of genomic data recovered). Thus, by adding DNA banking to their service spectrum, ESBS can considerably increase their visibility and public demand. Furthermore, they can foster knowledge aggregation at the biodiversity level around their ESBS samples, making these more valuable.

609 Discussion on environmental specimen banking in research and regulation

Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (II)

610 Poster spotlight: TH273, TH288, TH285

611 Environmental risk assessment of multiple stressors - chemicals and ionizing radiation

K. Petersen, NIVA - Norwegian Institute for Water Research; J. Brown, Norwegian Radiation Protection Authority; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Increased focus on cumulative effects of pollutants in the environment has led to the development of several methods for environmental risk assessment (ERA) of chemical mixtures and for ionizing radiation. Even though no generic impact and risk assessment model exists to accommodate different types of stressors (e.g., multiple stressors such as radiation, metals and organic compounds), larger harmonization and integration of approaches taken can be achieved to improve and combine the existing models for ERA of chemical mixtures and for ionizing radiation from radionuclides. Here we present a potential 2-tiered approach for risk assessment of multiple stressors by assuming additivity of chemicals and ionizing radiation as a first approach in order to combine a framework for ERA of chemical mixtures with the ERA for radionuclides. The proposed approach was applied to a real case scenario: emission from decommissioning of old oil platforms performed on-shore close to Vatsfjorden (Norway). Several metals, NORMs and organic pollutants are monitored as part of the activity. Effect data for the monitored compounds were compiled from various databases and literature. The Tier 1 identified a cumulative environmental risk of the stressors, and several metals and organics had a risk quotient above 1 (preliminary data). The potential for a cumulative environmental risk was verified in Tier 2 where species group specific risk was investigated. Metals were identified as the main risk drivers for algae, crustaceans and fish, where fish was identified as the most sensitive species group for this exposure scenario. Based on the used exposure scenario, compiled effect data and the suggested approach for ERA of multiple stressors, a potential environmental risk was observed. The main challenges and uncertainties for the proposed approach are linked to exposure data in terms of speciation and bioavailability; time consuming and subjective effect data compilation and assumption of additivity of ionizing radiation and chemical stressors. The approach for estimating environmental risk of multiple stressors requires validation through experimental studies, but could already serve as a suitable tool for prioritization of stressors and organisms of concern, and to identify knowledge-gaps in terms of exposure and effect data. Acknowledgements: The project was funded from NRC project 223268 (CERAD) and in-kind from Norwegian Institute for Water Research (NIVA)

612 Assessing health risk associated with micro-pollutant mixtures in drinking water: an innovative combination of in vivo and in vitro assays and analytical screenings

Y. Levy, Univ. Paris Sud / ESE UMR 8079; J. Loret, o. schlosser, CIRES E Suez Environment; a. guillon, Suez / CIRESSE; m. favier, INSERM Institut Cochin; v. domergue dupont, Université Paris Sud; M. Binbott, V. Huteau, Univ. Paris-Sud / UMR ESE; m. pleva, b. marinas, University of Illinois at Urbana Champaign Assessing health risks associated with organic micropollutants in drinking water is a major challenge for public health and improvement of the drinking water production units. Given the low concentrations, the diversity of emerging contaminants and chronic exposure, it is essential to combine chemical analysis with biotests. In vitro bioassays or in vivo tests on aquatic animals allow effect screenings but interpretation for health risk assessment is difficult. We have designed an innovative research program (to our knowledge, the first of its kind applied to drinking water) that aimed to simulate human life-long exposure to micro-pollutants in drinking water for in vivo tests on mammals... Over 4 seasons, we have concentrated by 100 the organic fraction from large volumes of 4 types of water: river water, drinking water produced by a treatment plant with this raw water as main input, rainwater and bottom mineral water. 2 generations of mice (10 males, 10 females for each type of water) were fed with contaminated drinking water during a 1 year period, in order to reproduce in the animals, the exposure as a man drinking the water over 70 years. We carried out complete chemical analysis (quantitative targeted analysis, innovative non-targeted screening by HPLC and GC-2D with mass spectrometry), offering a new vision of the contaminants diversity. In vitro bioassays were used to evaluate endocrine-disrupting effects (ER and AR recept.), cell toxicity tests (mammalian and Microtox) and genotoxicity on CHO cell assay. Mice growth, survival rate and behavior in open field and in elevated plus maze were studied. Histological analysis on 19 organs and blood hormonal assays were performed. This complete and innovative protocol did not show significant difference of survival rate and growth between the four mice groups. In contrast, histological and hormonal effects were observed in the mice exposed to the raw river water concentrates as opposed to the mice exposed to the waters of better quality. Several tests suggested a greater sensitivity of the 2nd generation mice as compared with the 1st-generation. Biotests confirmed the overall good quality of the treated water, whatever the treatment process, despite the presence of organic micropollutants. The presentation will show the detailed protocols, the major contaminants identified and the health risk assessment with regard to long-term exposure to real mixtures of organic pollutants in drinking water.

613 The application of DGT to assess the risk of metal mixtures in polar environments

D. Koppel, University of Wollongong / Chemistry; N. Adams, CSIRO: C.K. King, Australian Antarctic Division; D.F. Jolley, University of Wollongong / School of Chemistry

Contaminants predominantly occur in mixtures, posing a challenge to environmental management practices which are usually based on single-contaminant toxicity. Chemical interactions of the contaminants and non-specific biological responses to these mixtures may result in effects that differ from the sum of the toxicity of individual components. These differences can be classed as antagonism (less toxicity than expected from the sum of the individual contaminants in the mixture), non-interaction (toxicity equal to that expected from the sum of the individual synergic components that is greater than expected from the sum of individual contaminants). Diffusive Gradients in Thin-films (DGT) has been established as a robust method for analysing the biologically-available contaminants in situ and is well-positioned to assess the toxicity of contaminant mixtures. This study explores the use of DGT (with a Chleex-100 resin) to assess the toxicity of Cd, Cu, Ni, Pb, and Zn in mixtures, to two common Antarctic marine microalgae, Phaeocystis antarctica and Clythoecosmus antarcticus. Non-interactive and synergistic toxicity were observed in the two algal species in response to increasing multiples of an environmental mixture (where the ratios of metals were based on reported concentrations at a historically contaminated Antarctic marine bay). Non-interactive toxicity was observed in response to an equitoxic mixture (five metals at their EC10 concentrations), as determined by Independent Action and Concentration Addition modelling. DGT measured concentrations were able to predict toxicity to the two algae at environmentally realistic contaminant concentrations. The use of DGT in Antarctica was validated by field deployments to sediments and waters of the near-shore coastal environment of a contaminated site around an Australian Antarctic research station. Their use in assessing the risk of historical contaminants to the polar environment is discussed.

614 Ecotoxicity testing of environmentally realistic contaminant mixtures using passive samplers: what can we learn from repeating toxicity tests over an extended period of time?

B. Moore, Ghent University (UGent) / Laboratory for Environmental Toxicology and Aquatic Ecology; F. Vanryckeghem, Ghent University / Sustainable Organic Chemistry and Technology; S. Huysman, Ghent University; K. Demeestre, Ghent University / Sustainable Organic Chemistry and Technology - Research Group EnVOC; L. Vanhaecke, Ghent University / Veterinary Public Health and Food Safety; H. Van Langenhove, Ghent University / Sustainable Organic Chemistry and Technology; C. Janssens, Ghent University / Applied Ecology and Environmental Biology; K. De Schampaere, Ghent University (UGent) / Applied Ecology and Environmental Biology

In current environmental risk assessment, researchers assess effects caused by single substances to single species and extrapolate for realistic conditions where organisms are usually exposed to complex contaminant mixtures. The use of passive sampling opens new possibilities to work with such mixtures and to transfer them into biotest systems by either applying passive dosing (for equilibrium based samplers) or extract spiking (for integrative samplers). Our research objective was to investigate whether or not environmentally realistic contaminant mixtures
(ERCMs) have effects on marine phytoplankton and how effects could be explained by measured contaminant concentrations. Further we looked at the repeatability of our test results over an extended time period of 16 months. In the presented research we used extracts of Speedisk™ passive samplers deployed in and outside of the harbour of Zeebrugge (Belgium) to spike several 72 h growth inhibition tests with the marine diatom Phaeodactylum tricornutum following ISO 10253. The different growth inhibition tests were performed over a period of 16 months with tests 0, 8 and 16 months after extraction. We observed statistically significant (p < 0.05) growth stimulation of up to 6.4 ± 0.5 % and 11 ± 2 % (in the harbour) and 7.0 ± 0.5 % and 14 ± 3 % (outside of the harbour) after an extract storage time of 0 and 8 months, respectively. After 16 months the previously observed effects disappeared completely. In order to explain the differing ecotoxicological responses a targeted and systematic approach was applied including the identification of over 1000 microbial care products, pesticides, pharmaceuticals, (alkyl)phenols, phthalates and steroids. The analysis revealed that testing occurred at contaminant concentrations similar to those measured in water grab samples taken during sampler deployment. Remarkably the observed stimulation effects remained above 5 % when diluting the extracts up to 125 times. These findings suggest that P. tricornutum would remain affected by ERCMs even if their environmental concentrations would be reduced considerably. The disappearance of the observed stimulation effects after an extract storage time of 16 months led to the hypothesis that the main contributing contaminants causing stimulation must have degraded over time. In future work it would be of high interest to apply multivariate analysis (i.e. principal component analysis) to identify main contributing contaminants to the observed effects.

615 Marine Diatom Exposure to a Complex Mixtures of Fourteen Chemical Pollutants at Environmental Concentrations. What did we learn? D. Napiercska, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; R. Carvalho, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; I. Sanseverino, European Commission Joint Research Centre; S. Balzano, M. Potalivo, ISPRA Institute for Environmental Protection and Research; R. Loos, European Commission Joint Research Centre; D. Marinov, T. Letieri, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Thousands different chemicals are discharged into the environment from agriculture, industry, medical facilities, house-holds. Currently, there is an increasing concern for the environmental impact of mixture of compounds since the additive and eventual synergistic effects are unknown and could produce serious adverse effects. To address this issue, a joint effort of 16 European and associated research groups participated to an exercise to test a 14-substance synthetic reference mixture at safety environmental concentration under the Water Framework Directive (Environmental Quality Standard, EQS). The mixture, was tested on the own routine bioassays to investigate the chemical mixtures effects (Carvalho et al., 2014). The bioassays covered the entire ecosystem from bacteria to fish as well in vitro assays providing an unique scenario from ecological risk assessment perspective. The results showed that effects were observed at very low concentration on algal-bacteria composition in a marine microcosm, immobilization in crustacean, fish embryo toxicity and frog embryo development. Transcriptomics analysis was performed for the marine diatom Thalassiosira pseudonana exposed either to single compound or the mixture to investigate whether the single exposure and multiple exposure would show different gene expression profile pattern. The results show that the mixture induces a pattern similar to the ones induced by the single herbicides Duron and Isoproturon. Signatures induced by the Cdamanium or Nickel partially overlapped with the mixture signature. The exposure to the other compounds did in general not induce relevant signatures, although a weak overall consistent signature is present for some of them. In conclusion the effects of the mixtures could be explained mainly by the exposure to the two herbicides. Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (II)

616 How protective is the current risk assessment for soil invertebrates? P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; J. Roembe, ECT Ökotoxikologie Gmbh; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natale da Léia, University of Coimbra / Department of Life Sciences, University of Coimbra; S. Chelinho, CFE Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; N. Capela, CFE Centre for Functional Ecology; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products

The present risk assessment evaluating effects from plant protection products (PPP) as well as other chemicals towards soil organisms encloses uncertainties. According to the current practice on terrestrial ecotoxicology, the risk assessment for soil organisms exposed to PPP is based, in a first step, on results of standardised tests performed in artificial soil. This substrate is a mix of sand, peat, kaolinite clay and calcium carbonate and is not comparable to natural soils. However, limited data is available on the degree to which soil parameters influence the toxicity of chemicals for soil invertebrates in field soils, since toxicity is modulated by chemical sorption and bioavailability. Possibly, soil parameters like pH, organic matter content or texture, interact with each other in affecting the toxicity of different compounds to different soil organisms. These uncertainties in the accuracy of the lab to field extrapolation might contribute to the misunderstanding of the toxicology of test chemicals for organisms in natural soils. A screening project has been initiated in spring 2016, comprising a literature review aiming to investigate the effects of soil properties on the impact of PPP’s on soil organisms. The practical part of the project included laboratory studies on Eisenia sp. and Folsomia sp. on 4 PPP in 5 different soils. The results showed deviations on toxicity values obtained for single substances in different soils up to factor 6.4. The highest differences were detected for Folsomia sp. exposed to the active substance Pendimethalin in OECD10% and Lafa 2.1, respectively. So, the current risk assessment schemes for soil organisms based on standard laboratory studies performed with the surrogate species Eisenia sp. as well as Folsomia sp. is not always protective. Uncertainties in the assessment do exist regarding the effects of chemicals in natural soils towards other soil organisms, and other varying soil parameters that have not been investigated systematically so far (e.g. pH, clay content and interaction between them). The conducted literature research as well as the performed laboratory studies should be classified as preparatory work for more comprehensive studies. Focus of the future research should be set on the identification of key parameters influencing toxicity in different groups of species in order to create conceptual models allowing the extrapolation from the lab towards the field situation.

617 Risk assessment of soil organisms in field: dealing with earthworm community Y. Banyou, P. Brulle, ANSES / INRAU; A. Boveau, ANSES Centre / Senior Scientist; F. Brulle, ANSES / U3EIV; A. Boivin, ANSES, P. Lebec, INRAU, I. Schoeters, Rio Tinto; J. Chowdhury, International Lead Association / Senior Scientist - Environment

During the last 2 decades, intensive research has been performed to improve the risk assessment of metals in soil and numerous chronic metal toxicity data were generated for various terrestrial species and microbial functions in different soil types. Models were developed for correction for differences in bioavailability among soils and for differences between laboratory and field conditions. For many metals, the large amount of chronic toxicity data for different species and functions allow the application of the species sensitivity distribution approach (SSD) to derive soil quality standards. This work was mainly triggered by the European legislation on chemical management (REACH) and the data were therefore primarily used to derive specifications and no effect concentration (PNEC) for specific risk assessment. To facilitate a more flexible derivation of ecological quality standards for metals in soil for different protection goals (e.g. remediation thresholds), jurisdictions, regions or sites, while still making maximal use of the wealth of data and models already available, a metal soil threshold calculator tool has been developed. This freely available spreadsheet reports almost 1200 reliable toxicity data for the most direct effects of the metals Cd, Co, Cu, Pb, Mo, Ni and Zn to soil organisms (plants, invertebrates and microbial processes) and calculates ecotoxicological threshold concentrations expressed as (pseudo-)total (i.e. aqua-regia extractable) metal concentrations in soil (mg/kg dry weight). All metals covered have sufficient chronic toxicity data allowing the derivation of an SSD. The soils used for ecotoxicity testing cover for each metal a wide range of soil properties, making the results representative for most regions in the world. Several options are included to allow calculation of metal soil threshold concentrations for various goals (e.g. risk assessment or setting of remediation thresholds for different land uses): selection of organism groups or species to be considered, selection of
Wood-fibres composite in substitution of a synthetic material to enhance sustainability purposes for automotive sector

A. Toschki, Research Institute gaiac; M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research

It is recently discussed and is widely accepted that species diversity and habitat quality dramatically decreased in the last decades due to the increasing intensity of agricultural land use. The decline was proved for various species groups, such as soil arthropods, insects, butterflies, birds etc. With the loss of species also a variety of benefits and ecosystem services that were provided by the species dropped away. This is not only a matter of conservation but also one of agriculture, with that latter can be quoted as a decisive factor, but the all explaining reason for this inacceptable loss of biodiversity cannot be assigned easily to a single factor and is more due to a multifactorial complex of influences which is responsible as a whole. In current risk assessment procedures, single pesticides were authorized individually independent of the current status of biodiversity in the field and possible effects of the combined or sequential use. Additionally there is no treatment on account of the use of pesticides on specific sites available. At the same time there is a lack of knowledge about the development of biodiversity in different agricultural landscapes because monitoring programs have not been established so far. The establishment of a systematic monitoring and a landscape risk assessment is necessary to connect future risk assessment with biodiversity as the protection target. Furthermore good ecological values must be derived and thus for the whole of the life operating range must be defined. When the biodiversity level falls below the thresholds measures must be carried out. Geospatial models can help to optimise sustainable agricultural practice and measures for risk mitigation. The presentation will summarize result from different projects.

620 Potential new soil test requirements for the risk assessment of pesticides in the European Union: do we have the right methods?

R. Roembke, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences

European Food and Safety Authority (EFSA) published a Scientific Opinion entitled “Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms”. This document summarizes various scientific issues relevant for the risk assessment of plant protection products (PPPs) for in-soil organisms, i.e. micro-organisms and invertebrates (plants are covered in another EFSA document). The aim of this publication is to identify the safe operating range for the PPPs in soil ecotoxicology, but – more importantly – it also summarizes the scientific background for a new approach. In the future, soil risk assessment should be based on the ecosystem service approach, meaning that important services at agricultural landscapes (e.g. nutrient cycling, soil structure maintenance, just to name a few) have to be protected. In consequence, protection goals for soil organism communities, i.e. their biodiversity and functions relevant for providing these services, have to be defined. This contribution will focus on one important question, assuming that the new risk assessment approach is put in practice: Do we have the appropriate (e.g., scientifically sound, robust, standardized) methods to cover the new data requirements? In this contribution we focus on four aspects of the new methodology: Organism groups, endpoints, soils, regions (i.e. agricultural practices are not covered). In fact, there are various research needs which have to be addressed asap, i.e. before the new requirements will be put in practice. We focus our discussion on those test systems which are already standardized (or which are in the process of being standardized in the foreseeable future). Besides OECD also methods published by ISO or national organisations such as Environment Canada are considered, knowing that the latter often have to be adapted in order to cover the specific needs of PPP environmental risk assessment schemes. In addition, the same criteria as in other comparable approaches will be used and examples of suitable methods will be given. Most important is whether they can be modified in a way that they are useful under the upcoming EFSA regulations.

621 Poster spotlight: TH154, TH155, TH156

Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking

G. Mondello, University of Palermo; M. Cellura, M. Mistrutta, University of Palermo

The intensive use of pesticides has caused a major decline of various species groups, such as soil arthropods, insects, butterflies, birds etc. With the loss of species also a variety of benefits and ecosystem services that were provided by the species dropped away. This is not only a matter of conservation but also one of agriculture, with that latter can be quoted as a decisive factor, but the all explaining reason for this inacceptable loss of biodiversity cannot be assigned easily to a single factor and is more due to a multifactorial complex of influences which is responsible as a whole. In current risk assessment procedures, single pesticides were authorized individually independent of the current status of biodiversity in the field and possible effects of the combined or sequential use. Additionally there is no treatment on account of the use of pesticides on specific sites available. At the same time there is a lack of knowledge about the development of biodiversity in different agricultural landscapes because monitoring programs have not been established so far. The establishment of a systematic monitoring and a landscape risk assessment is necessary to connect future risk assessment with biodiversity as the protection target. Furthermore good ecological values must be derived and thus for the whole of the life operating range must be defined. When the biodiversity level falls below the thresholds measures must be carried out. Geospatial models can help to optimise sustainable agricultural practice and measures for risk mitigation. The presentation will summarize result from different projects.
few information regarding the environmental impacts connected to the life cycle of the charging infrastructures to operate the EVs, and, in particular, regarding the environmental performance of charging station for e-bicycles. This study aims to evaluate, through the application of the LCA method, the environmental burdens of a stand-alone charging station for electric bicycles manufactured in Italy, assuming its installation and utilisation in Italy with a lifetime of 15 years. The investigated scenario is composed of eight designated positions for charging the e-bicycles’ battery and of two wind-solar modular systems that are respectively equipped with one photovoltaic (PV) module and three low profile vertical axis wind turbines. The structure is also geared with a system connected to the conventional electricity grid which allows to provide energy when the wind and solar conditions are insufficient. The analysis also includes the whole life cycle of e-bicycles, including as the potential avoided production of conventional electricity which may be replaced by the electricity surplus produced by the wind-solar system. The functional unit (FU) adopted to perform the analysis is one charging station installed in Italy and used for a lifetime of 15 years. System boundaries follows a cradle-to-grave approach and include four main phases: 1) production phase, 2) installation phase, 3) use and maintenance phase, and 4) end of life phase. The results indicate that the Climate Change impact related to the whole life cycle of the investigated charging station is 13,816.5 kg CO2 eq per FU. The main environmental impacts are due to the production phase and, in particular, are connected to the production of the e-bicycles, while higher environmental benefits are connected to the replacement of conventional electricity with the energy surplus produced by the wind-solar modular system installed on the charging station.

625 Raw materials requirements scenarios for the electric mobility penetration in the Italian urban vehicle fleet: a life cycle thinking approach combined with raw materials assessment

L. Cutaia, C. Chiacchiari, P. Porta, ENEA; M. La Monica, C. Scagliriano, CINiGeo

The automotive fleet is gradually changing from internal combustion to hybrid and electric engines. This is fostered by the European policies concerning the need of reduction in pollutant emissions and in the improving of urban air quality. Currently most of the analyses carried out focus on the comparison of the emissions related to the different typologies of cars and on the CO2 emission cut generated by the consumption of electricity produced from renewable sources in the use phase of the car. The proposed approach wants to investigate the need of raw materials in future scenarios of electric technology penetration in the urban vehicle fleet. Focusing on the Italian urban vehicle situation and considering the current technology used for the electric batteries and the recharging systems, the study account for the raw materials needed for that penetration and the electric mobility adopting a Life Cycle Thinking perspective. The authors have been beyond a mere quantification of the primary materials required for the progressive electrification of the urban fleet, evaluating the raw materials availability from a market perspective and defining the limiting factor among three basic material of the current electric technologies (lithium, graphite and manganese). Therefore this work, starting from an evaluation of the material needed for different electric mobility penetration scenarios in the Italian urban fleet, wants to highlight the market dynamics especially for 3 primary materials widely required in the electric mobility focusing also on the possibility offered by a transition to a circular economy, investigating the green mining potential available for these materials both for their recovering in the same technology and in others fields.

626 Coupling dynamic carbon accounting and partial-equilibrium economic model for energy policy assessment

A. Alberts, P. Collet, D. Lorne, IPPEN / Economics & Technology Intelligence; A. Benoit, CIABD / UPR BioWoob ELSA research group; A. Hélias, Montpellier SupAgro / IBE ELSA

Energy production and consumption is the main driver for anthropogenic GHG emissions, and in the French context, the transportation sector is the principal emitter accounting for almost one third of these emissions. The growing need to reduce GHG emissions and mitigate climate change demands tapping alternative energy resources, as efficiently enforced by energy policies (e.g. the French Transition for Growth Act). LCA scholars increasingly assess the environmental performance of the advance biofuels, but mainly from a static perspective. Results are therefore limited to linear simplifications, whereby long-term impacts might be neglected or underestimated. New dynamic LCA approaches have been suggested, however no consensus is available on how to treat Cbio sequestration dynamics over different timeframes. This study further addresses the temporal shortcomings of bioenergy systems while considering future outlooks and consequences on the market dynamics. The approach consists of a hybrid approach combining the MIRET energy systems model with dynamic Cbio accounting models towards dynamic LCA. The latter assess biomass growth and allometric relations representing the Cbio fixation of a vegetation species per hectare on an annual basis, and thus the time-dynamic Cbio flows between the atmosphere and the technosphere. The assessed Cbio flows primarily originate from lignocellulosic biomass and their co-products generated from MIRET outputs under business as usual and normative scenarios. The transformed Cbio inventories are then combined with both dynamic and static LCA characterisation factors, towards a comparison of both approaches. The results show that the time factor is an essential component to properly assess long-term Cbio sequestration potentials and climate benefits of lignocellulosic biofuels. The combination of technological innovation and market dynamics in a transitioning energy system expands the assessment boundaries providing insights into least cost (economic optimisation) and low carbon (Cbio sequestration) options influenced by policy and decision constraints. Future refinements addressing other bioenergy paths are envisaged.

627 Poster spotlight: TH304, TH309, TH314

Developments in the use of bioassays for chemical and environmental risk assessment (II)

628 SIMONI: Smart integrated monitoring of the water quality

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At present, regular water quality assessment is almost exclusively performed by target chemical analysis of substances. Scientific research over the last decades, however, demonstrated that water quality assessment with only chemical analyses is not reliable. Since over 100,000 harmful substances may be present in the aquatic environment, a paradigm shift from ‘substances’ to ‘effects’ has to be encouraged in order to implement a more holistic approach in regular monitoring. Therefore, an alternative Smart Integrated Monitoring (SIMONI) strategy has been developed by Dutch water research institutes. The purpose of this 2-tiered strategy is to obtain more reliable information on the chemical water quality without increasing the monitoring costs. Key factors for generating this model were the selection of the most relevant bioassays and the design of effect-based trigger values (EBT). Tier 1 of the strategy combines micropollutant concentration by passive sampling with testing of 15 biocatalytic endpoints. This hazard identification makes the distinction between low, acceptable and increased ecological risks. Only at sites where tier 1 indicates increased ecological risks, a customized tier 2 research is performed to identify the chemicals that cause the bioanalytical effects and to evaluate if observed in vitro effects pose a serious in vivo threat to the ecosystem. The present paper is focused on demonstrating the field feasibility of the SIMONI strategy. The strategy has been applied and validated in more than 100 Dutch field studies. Results of several of these monitoring studies will be presented in order to demonstrate the field feasibility for the SIMONI strategy for identifying hot-spots of chemical pollution. It applies especially to occur more generally at agricultural sites. In addition, increased ecological risks were also observed at waters receiving wwp effluents, sewage overflows and landfill runoff. A tier 2 approach is the assessment of the mixture toxic pressure on the ecosystem by using chemical analytical results for mPSAP determination (potentially affected fraction of water organisms due to multiple stressors) at hot spots with increased ecological risks due to micropollutants, similar classifications were obtained with bioanalytical and extensive chemical analyses. The tier 2 research at agricultural greenhouse areas identified eight pesticides contributing most to the increased environmental risks.

629 Bioassay battery responses to POCIS and Speedisk passive sampler extracts

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A large portion of the total chemical load on surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. The effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. The effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. The effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. The effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. The effects observed in surface water cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body.

Poster spotlight: TH304, TH309, TH314
samplers, the often used polar organic chemical integrative sampler (POCIS) and the recently introduced Speedis, POCIS and Speedis passive samplers were simultaneously deployed at sites likely to be contaminated with polar compounds, including agricultural greenhouse sites and wastewater treatment plant (WWTP) impacted locations. The extracts of the passive samplers were subjected to a battery of bioassays, specifically responsive to polar compounds, including ERu-, anti-AR and GR chemical activated luciferase gene expression (CALUX) bioassays, as well as the RIKILT WaterSCAN for antibiotics activity. In addition, the Microtest test for non-specific toxicity to bacteria was run. The two investigated passive sampling devices generated a different toxicity profile in the applied bioassay battery, with several unique responses per passive sampler. Nonetheless, POCIS caused bioassay responses more frequently and more intensely, leading to more frequent trigger value exceedences and thereby to the detection of ecotoxicological risks. Hence, POCIS outperformed Speedis in most bioassays at the majority of the investigated locations. These results thus suggest that POCIS is best fit for application as passive sampling device targeting polar compounds in effect-based water quality monitoring strategies.

630 Endocrine modulation and toxic effects of sunscreen chemicals, Octocrylene and Benzenophene, on zebrafish Q. MENG, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences

Sunscreen chemicals are used to prevent the skin and hair of human from the harm of ultraviolet light, and they are widely applied in a variety of personal care products. These materials are discharged to the environment continuously as daily care products. At present, many kinds of UV filters are found in surface water and polluted water, and their concentrations in the urine and blood of human are much higher than that in the environment, indicating that the UV filters have the possibility of bioaccumulation to cause toxic effects in the accumulated organisms. Benzophenone-3 (BP3), benzophenone-1 (BP1), benzophenone-2 (BP2), benzenophene and octocrylene (OC) are four such chemicals that have been detected in environmental samples and linked to alterations in estrogen receptor signalling pathways and oxidative stress. In this study, zebrafish larva and a liver cell model of zebrafish liver cells, the ZFL cell line, will be used to investigate the potential risks of BP3 and OC and the molecular mechanism underlying the toxic effects. Docking analyses, 24 h and 96 h chemical exposures will be conducted on the ZFL cells to determine the potential binding affinities to the estrogen receptor (ER) and the half-lethal concentration (LC50) for the UV filter chemicals. The gene expression profiles on the ER pathway and the aryl-hydrocarbon receptor (AhR) pathway will also be measured by quantitative real-time PCR in ZFL and larvae exposed to the sunscreen chemicals. A dual-luciferase reporter gene system with AhR and ER clones transfected in ZFL cells will be used to confirm the biological activities of these sunscreen chemicals in ZFL cells.

631 Current status of in vitro bioassay approach in environmental risk assessment of biotic environmental mixtures and individual organic contaminants M. Machala, Veterinary Research Institute / Chemistry and Toxicology; K. Penčíková, S. Strápáková, Veterinary Research Institute, Brno / Chemistry and Toxicology; L. Svrčková, Veterinary Research Institute, Brno / Chemistry and Toxicology; J. Neca, M. Ciganek, Veterinary Research Institute, Brno / Chemistry and Toxicology; I. Bartonková, Z. Dvorák, Faculty of Science, Palacky University, Olomouc; I. Topinka, J. Vondráček, Institute of Biophysics, CAS, Brno

Since 2001, our laboratory has continuously employed an ever growing set of in vitro bioassays, specifically responsive to polar compounds, i.e. AhR-dependent reporter gene assays, in order to identify principles modes of action of contaminants bound to river sediment, airborne or diesel exhaust particles. Toxicity profiling of selected individual contaminants was used as a complementary approach, which aimed to identify major toxic modes of action and principle contributors to specific toxicity effects. The AhR-mediated activity has been recognized to play a key role in toxicity of organic extracts of abiotic environmental mixtures. Using the DR-CALUX assay, we established relative effective potencies (REPs) of large number of polyphenolic aromatic compounds, including PAHs, methyl-, nitro- and oxy-PAHs, thiophenes, dinitrophenol, benzo[a]pyrene and carbazoles, which complemented the available data on polychlorinated biphenyls, dibenzop-dioxins and dibenzofurans. Recently, we also developed REP values in human AhR-dependent reporter gene assay, in order to compare the potency in rodents and human models. Using a set of various CALUX assays, we have established a systematic toxicity screening analysis using qRT-PCR methodology as well as non-receptor-based toxicity screening methods including estimation of stable DNA adduct production, oxidative DNA and lipid damage, and inhibition of cell-to-cell communication, we further studied toxicity profiles of both mixtures and selected individual compounds to induce (anti)estrogenic, (anti)androgenic, TRα/n, CAR, PAR- or other receptor-mediated activities of both environmental mixtures and selected individual classes of organic contaminants. The general outline of those studies will be illustrated using an example of a detailed in vitro toxicological evaluation of standard reference material of diesel exhaust particles (SRM 2975), with an aim to document both the complexity of the observed effects and the difficulties faced when applying these data in risk assessment of complex mixture. [The study was supported by the Czech Science Foundation, grant no. P503-12-G147.]

632 Hormone-like activities in waste water characterized by CALUX bioassays, chemical analysis and Effect-directed Analysis Y. van Oorschot, R. ten Broek, The Water Laboratory; M. Lamoree, VU University, Department Environment & Health / Department Environment & Health; N. Zwart, VU University Department Environment & Health; C.J. Houtman, The Water Laboratory

Emission of compounds with biological activities from waste water treatment plant (WWTP) is an issue for aquatic environments and drinking water companies. We investigated the occurrence of hormone-like activities in WWTP samples and pursued to identify compounds responsible for them. To this aim, CALUX bioassays and a UPLC-Q-TOF mass spectrometry were used to separate compounds in the extracts with high resolution LC-fractionation and to elucidate the identity of the unknown glucocorticoids. Also bioassaychromatograms of other endpoints will be discussed. This study demonstrates the value of toxicity profiling with bioassays as first tier in the monitoring of water quality. In case observed activities exceed trigger values, additional risk assessment is needed and the HT-E DA platform can help to characterize and ultimately identify the responsible compounds.

633 Non-target screening and identification of emerging pharmaceuticals and their transformation products in wastewater c.G. Pauwels, only found in Bordeaux, UTC / LPCP UMR 5805 CNRS; M. Dèvieux, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; E. Mailot-Maréchal, INERIS / UMR SEBIO ECOT; E. Geneste, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; S. Ait-Aissa, INERIS / UMR SEBIO ECOT; H. Budzinski, University of Bordeaux

Wastewater represents a major pathway of introduction of EDCs into the aquatic environment. Considering the high diversity of medicaments and their possible transformation products, many EDCs are currently unknown. Therefore, characterization of the presence and identification of EDCs in wastewater are major issues in order to assess their occurrence in natural waters and the associated risks for wildlife. To date, in vitro assays based on luciferase reporter gene expression, are available to assess the biological activities of samples in a quantitative, sensitive, specific and fast way. The comparison of concentrations derived from bioassays and from chemical analyses allows assessing the contribution of micropollutants to the overall biological or toxic activity of a sample. In this study, a systematic approach combining effect-directed analysis (EDA) and high resolution spectrometry was applied to several urban WWTPs to establish an overall contamination diagnostic and to identify major contaminant that could be released in environment. For this purpose, crude extract from influent and effluent of an urban WWTP were analyzed by LC-QTOF and tested on estrogens, androgens and glucocorticoid receptors. The non-target screening allowed detecting more than 7000 and 4000 signals in influent and effluent extracts of WWTP, respectively. We observed that 70% of compounds detected in effluent wastewater were introduced by the treatment process suggesting the formation of transformation products. Concerning the strategy implemented to identify compounds of interest, it was decided to use effect-directed analyses methodology to have a tool to target active compounds in relation with selected biological activity. To this end, the crude extracts were fractionated by HPLC and biologically active fractions were isolated for further chemical identification. Biological fractionation profile of samples indicated the presence of estrogenic and glucocorticoid activities at all studied sites with very similar fractionation patterns between sites, highlighting major and recurrent individual fractions. The identification of active compounds was performed using LC-QTOF and several drugs and their transformation
products (e.g. O-desmethyl venlafaxine, O-desmethyl tramadol) were recurrent found. This approach combined to LC-QTOF has allowed establishing a list of systematic detected non-target compounds in several wastewaters.

Indigeneity and Science: A collaborative work in progress

634 The Nechako White Sturgeon Recovery Initiative: A discussion of species at risk conservation, scientific outreach, community and First Nations support

T. Lane, University of Saskatchewan; C. Williamson, Freshwater Fisheries Society of British Columbia; S. Shekhtman, University of Saskatchewan / Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Nechako white sturgeon (Acipenser transmontanus) are a genetically unique population of fish which have inhabited the Nechako watershed for roughly 10,000 years. Within the last 50 years this population has suffered significantly because of activities associated with the Construction of Managed Water in Canada identified the Nechako white sturgeon as a Nationally Significant Population. In 2006, this population was further listed as endangered under the Species at Risk Act. Prior to both designations in 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established in Vanderhoof, British Columbia. The goal of the initiative is the conservation and recovery of this one-of-a-kind population of white sturgeon which hold intangible cultural value within communities surrounding the Nechako watershed. A 5-million-dollar aquaculture facility, the Nechako White Sturgeon Conservation Centre was designed specifically for the NWSRI, built, and opened in 2014 to provide the resources to further support this conservation effort. This facility was a product of over a decade of work by a Technical Working Group (TWG) and a Community Working Group (CWG). The TWG includes biologists, industry and First Nations members who have a vast knowledge of white sturgeon. The goal of the TWG is to use the best available science, local and traditional knowledge to determine why the Nechako white sturgeon population is declining and to develop a plan to rehabilitate this population of fishes. The CWG is composed of First Nations members, local and regional government representatives, and public volunteers. The CWG plays a vital role in communication, public outreach, and promoting community involvement. Activities of TWG and CWG support the mandate of the NWSRI through direct involvement of First Nation communities, volunteers and students. The Emergency Sturgeon Live Release Boat Kit program is an example of multiple First Nation communities working in union with the NWSRI to promote conservation and stewardship of Nechako white sturgeon. The annual Juvenile Sturgeon Release event involves students, volunteers and First Nations who release thousands of juvenile sturgeons, which were reared from eggs by the TWG, back into the Nechako watershed. The NWSRI is a unique conservation effort that promotes and utilizes the support of scientists, First Nations, volunteers and students to engage the community in the conservation of an endangered species.

635 The NSERC CREATE H2O Program on First Nations Water and Sanitation Security: Case Studies on Drinking Water Quality

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The NSERC CREATE H2O program is the first science-engineering research training program in Canada that combines technical water and wastewater management training with Indigenous theory, law and methodological skills training. Since its inaugural year in 2013, the program has trained 86 students who have collectively worked with 30 First Nations communities in the provinces of Manitoba, Ontario and Saskatchewan, Canada. 33% of the university students and postdocs enrolled in the program self-identify as Indigenous. This presentation provides an overview of the approaches the program uses for: engaging communities and students in research training activities, Indigenousizing science and engineering curricula, and designing advocacy strategies to support clean drinking water as a human right in First Nations communities in Canada. Case studies are presented to demonstrate the community-based monitoring programs implemented to examine drinking water quality in First Nations homes. First Nations communities participating in the research had various types of water distribution systems. Overall, water samples were collected from: lakes and groundwater (source water); water treatment plants, water trucks and community standpipes; homes relying on piped water, wells, above-ground cisterns and underground cisterns; and buckets/drums in homes without running water. Water analysis included standard measures of chemical and bacterial parameters, DNA and RNA techniques for microbial profiling, and the quantification of antibiotic-resistance genes in water samples. The main findings are that despite effective water treatment plants in communities, the tap water in many First Nations homes contained fecal bacteria at alarmingly high levels and antibiotic-resistance genes were also detected in a range of drinking water samples. The issue of poor drinking water quality in First Nations communities in Canada remains unsolved and there is an urgent need for improved monitoring and upgrading of infrastructure, especially in communities relying heavily on cisterns and community standpipes for drinking water supplies. Most importantly, investments to connect homes directly to water treatment plants via improved pipelines is key to reducing human exposure to waterborne illnesses, while enhancing options for families to participate in economic development, food security and spiritual and cultural wellbeing in their communities.

636 Rare earth elements (REEs) in the Canadian Subarctic: scientific perspectives and community engagement with environmental monitoring in Nunavik, Northern Quebec

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Many communities in Canada’s North are increasingly concerned about the impacts of large-scale socio-environmental changes, such as climate change and insecurity important on both biotic life. One community for Indigenous communities is the environmental impact of mining, including the large number of rare earth element mining projects that are currently being developed in northern Canada. Rare earth elements (REEs) are a chemically-similar group of contaminants of emerging concern, which includes the 15 trivalent lanthanide metals. Not particularly rare, REEs are increasingly exploited for essential uses in high-tech industries, including electronics, clean energy, and agriculture. Although knowledge of the fate of REEs and their impact on natural ecosystems is critically needed as emissions increase, few ecotoxicological studies exist for REEs particularly field studies on their bioaccumulation and food web dynamics. To investigate how REEs behave in remote northern food webs, samples were collected from community-driven collaborative research projects with the Inuit communities of Kuujiuarapik-Whapmagoostui (K-W) and Kangisualuiajuq in Nunavik (Northern Québec). The combined objectives of these projects were a) to study the behaviour of REEs in northern ecosystems before the start of mining activities and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. We present perspectives from a research and community engagement: Can we detect REEs in freshwater, marine and terrestrial plants and animals? Do REEs bioaccumulate and bioamplify in northern food webs? How to best establish a sustainable community-based environmental monitoring program? Can we engage the youth in environmental monitoring and science education? Wildlife harvesting and tissue sampling was partly conducted by local hunters, including a range of key species of large mammals and fish. A unique research approach combining Indigenous knowledge was used in the study design, to coordinate local sampling, and to decide when, where and what species to collect. Our study presents novel data on the behaviour of REEs in northern ecosystems and recommendations for establishing sustainable and effective community-based environmental monitoring projects with indigenous communities for emerging contaminants.

637 Te Ohu Mō Papatūānuku: A Collective Response to Healing

T. Godfrey, H. Hirere, Te Whare Wanga O Awanuiarangi / School of Undergraduate Studies

The use of pentachlorophenol (PCP) as an anti-sapstain in timber treatment, with subsequent disposal of chemically treated wood waste in the Whakatane District of New Zealand has resulted in a legacy of contamination. There are 36 identified wood waste sites located on private and public lands, as well as the customary lands and waters of the indigenous Ngati Awa people. The pervasive effects of contaminants upon both human and environmental health has led to the formation of a collaborative environmental monitoring program that is supported by indigenous members of Ngati Awa, whilst being strongly supported by scientists, local government agencies, and industry. As a consequence of ongoing research, the use of a rather unique approach utilising combined myco- and phytoremediation to remediate dioxin-contaminated land has been adopted. Whilst implementation of the approach is underpinned by science, the use of “nature to heal nature” is an approach that resonates with the indigenous community. Contemporary environmental problems resulting from anthropogenic activities often require the use of scientific based solutions. Hence, even when indigenous participation is encouraged by the scientific community as part of the problem solving process, the contribution of indigenous knowledge may be considered of less value than scientific knowledge. Of vital importance to ongoing environmental governance however, is the role of indigenous knowing – indigenous relationships informed by binding and enduring familial links with lands, waters, and people. This presentation builds upon previous presentations detailing the journey of the Te Ohu Mo Papatuakuru research collaboration – using a synchronistic approach –
whereby science is an integral remedial component and provides a vehicle for remediation to occur, but cultural and soul connections of the indigenous people are the drivers of reciprocal remediation, and subsequent healing. Scientific knowledge applies science and indigenous knowing revitalises relationships, informing and infusing behaviour with an ethos of respect, empathy, and reciprocity.

638 Discussing the Unfamiliar but Contentious: Hydraulic Fracturing Consultation with Remote, Indigenous Communities in the Northern Territory, Australia

R. Smith, Hydrobiology Pty Ltd; R. Pepper, Land and Environment Court of New South Wales; D. Ritchie, Ninti ONE Foundation

On 18 September 2016 the Northern Territory (NT) Government announced a scientific inquiry into hydraulic fracturing of onshore unconventional reservoirs in the Northern Territory (the Inquiry) under the Inquiries Act (NT). The Inquiry was required to assess the available scientific evidence to determine the likely nature and extent of the environmental impacts and risks, including cumulative impacts and risks, associated with hydraulic fracturing of unconventional reservoirs and the Associated Activities in the NT. The Inquiry was specifically instructed to assess whether or not there would be unacceptable impacts or risks to economic, cultural and social conditions, by developing and implementing a stakeholder engagement program. Indigenous people make up most of the resident populations in the areas of the shale-gas basins in the Northern Territory. Indigenous people are linked with their land (including waterbodies) by their ancient traditions and continue to use their land in accordance with those traditions. As a community, they must be able to maintain their cultural traditions relating to that land in order that their ownership rights continue to be recognised, from one generation to the next. Indigenous communities are therefore particularly vulnerable to degradation of the landscape and the natural systems it supports. Therefore, the Inquiry undertook focused stakeholder consultation with remote indigenous communities across the NT as part of visits in remote communities and hearings. These could not be conducted in the same manner as larger community consultation, and featured language and background knowledge barriers that are not typical of even remote non-indigenous community consultation in Australia. A number of these issues, and how they were addressed are discussed. Although the timeframe allotted to the Inquiry was particularly challenging for indigenous community consultation, and hence the extent of engagement in the process varied greatly between communities, nonetheless the Inquiry did achieve substantial engagement with most. The community feedback gained thereby was a vital input into the Inquiry’s assessment of the potential cultural impacts of shale gas development in the NT.

639 Incorporating cultural values and perspectives of First Peoples’ (Aboriginal) People into water planning, science and environmental water management

B.J. Moggridge, Institute for Applied Ecology, University of Canberra / Institute of Applied Ecology

Australia is the oldest inhabited continent on Earth, yet is has been the traditional lands of its original inhabitants Australia’s First Peoples for thousands of generations. Protecting water landscapes (surface and ground water) has always been a high priority for survival in a dry landscape, and protecting water remains a cultural obligation. The challenge for First Peoples is to ensure their value and relationship with water is not diminished or excluded by modern day water planning and science or from the environmental flow management. First Peoples acquire the right wisdom and traditional science and knowledge and many indicate that their worldview is seeing water as inseparable from the land and the sky, bound in the traditional lore and customs for its protection. For Australia’s First Peoples, occupying an ever drying landscape, traditional knowledge of finding, re-finding and protecting water sites has been integral to their survival for so long. This paper will explore relationships between First Peoples and water planning and environmental water management in three ways. Firstly, history, challenges and institutional responses in integrating First Peoples cultural values into water planning, science and management. Secondly, propose a series of on-the-ground applications of cultural water and environmental water empirically. Finally, integrating First People’s science into water management will be assessed through comparisons between the Australian situation through case studies looking at models and methodologies.

Improvements in environmental exposure assessment: Development and application of tools across industry sectors, regulatory agencies, and international boundaries (II)

640 Tap water intake of poly- and perfluoralkyl substances (PFASs) in relation to serum concentrations in a nationwide prospective cohort of U.S. women

X. Hu, F. Laden, Q. Sun, P. Grandjean, Harvard University; L.W. Yeung, University of Oerebro / Department of Chemistry; E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences

Drinking water advisory levels have been adopted by many regulatory agencies to reduce chronic exposure to persistent fluorochemicals. However, most U.S. advisory levels are based on the assumption of approximately 20% of overall PFAS intake comes from drinking water. Better characterizing the relative importance of drinking water to overall human exposures is important for developing health protective guidelines. Most previous investigations that have associated drinking water PFAS exposures and total body burdens of these compounds have focused on highly contaminated sites. Exposure to PFASs for the general population of individuals from geographically diverse areas are thus less understood. Here we investigate the relative importance of drinking water for total PFAS exposure among women in the Nurses’ Health Study (NHS), a large U.S. based cohort study. Our analysis included U.S. women who provided a residential drinking water sample in 1989-1990. We measured concentrations of 11 PFASs in a subset (n=755) of archived drinking water samples and serum samples. We evaluated the relative importance of home tap water for measured levels of PFASs in human using both statistical and toxicokinetics (TK) models. Results suggest that home tap water is a significant exposure source for general American women. In 1989-1990, the median contribution of drinking water to serum PFASs in women in the NHS cohort was 8.8% to 30% for the five PFASs modelled. This ratio varies across individuals and increases to up to 80% for C-2F. We will investigate how this ratio varies geospatially and whether it is associated with distance to well-known point sources. The spatial analysis results will also be discussed in the presentation. By comparing PFAS concentrations in archived tap water sample with recent tap water samples matched on the township, we found the fraction of quantifiable PFASs (i.e. known PFASs) has decreased in most towns and unknown extractable organic fluorine (EOF) has increased. Our analysis suggests tap water may be a significant exposure source for five PFASs among a group of U.S. women from diverse geographical areas. Increases in unquantified EOF in recent tap water suggest additional quantification would be worthwhile. Other exposure sources such as consumer products are suspected to dominate overall exposure of individuals in the NHS cohort prior to the restrictions and regulations of legacy PFASs in the U.S.

641 Consideration of the bioavailability of metals and metal compounds in freshwater in regulatory frameworks

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Recent research has demonstrated that both total and dissolved metal concentrations are not the most appropriate parameters for the risk assessment of metals in aquatic systems. There is an increasing awareness by leading regulatory bodies in the USA, Europe and other countries that the bioavailable fractions of metals could be better descriptors of their risks. The principal concept of metal bioavailability is the Biotic Ligand Model (BLM) which allows site-specific assessments of metals’ risks by considering the environmental factors which determine the bioavailability of dissolved metals in the aquatic environment. For many metals bioavailability in freshwaters is modulated by dissolved organic carbon (DOC) concentrations, water hardness, the pH of the water and other factors such as temperature, concentrations of further ions and suspended solids as well as metal speciation. Metal-specific BLMs were proposed for different biological species and both, acute and chronic exposures. The BLM approach has been described extensively in the scientific literature, and BLMs have been applied for the risk assessment of metals and metal compounds (e.g., for copper and zinc in the EU). In the past, the broader use of the BLM approach for the site-specific evaluation of surface water monitoring data was hampered by the huge data requirements of the original BLMs (several site-specific water parameters). But the recent development of user-friendly BLM-based bioavailability tools (e.g., www.Bio-met.net, www.PNEC-pro.com) now allows the consideration of metal bioavailability for the evaluation of freshwater monitoring data of relevant metals. Such tools, which only need a basic set of easily available water parameters as input (mostly pH, Ca concentration, DOC, and dissolved metal concentration), are currently available for metals such as lead, nickel, copper and zinc. The new EU Water Framework environmental quality standards for lead and nickel according to Directive 2013/39/EU now consider the bioavailable fractions of these metals. In this contribution, the advantages and possible drawbacks of BLM-based bioavailability tools are presented highlighting feasibility, ranges of validity, and comparability between tools. Finally, recommendations for the regulatory implementation are given. This contribution is based on the outcome of the IUPAC-supported project “Consideration of bioavailability of metals/metal compounds in the aquatic environment” (#2011-060-1-600).
Age-Based and Time Trends of Exposure Chemical Biomarkers in the US Population 1999-2014

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When interpreting biomonitoring data, we are limited by the cross-sectional nature of biomonitoring data and incomplete longitudinal data. It is important to differentiate between the potential influential of temporal determinants on legacy exposure, versus current exposure that may be due to relevant consumer product usage. In addition, an overarching systematic approach to study monitoring exposure for a broad set of chemicals is missing. We developed a method to evaluate and compare age-specific exposure trends for 229 chemicals in the US population. Chemical biomarker measurements and demographic traits were obtained from the National Health and Nutrition Examination Survey (NHANES) datasets for the years 1999-2014 (n = 74,942). We extracted the persistence of chemical biomarkers from 16 different classes of chemicals from databases, literature review, and Quantitative Structure Activity Relationships (QSAR) when needed. To compare differences in chemical biomarker concentrations across the age groups, we partitioned the distribution of each chemical biomarker by 12 different age groups, which were defined based on age-specific behaviors. To evaluate the influence of age on the chemical exposure biomarker concentrations, we performed a series of biomarkers that have been found to be indicative of current exposure as well as age-specific behaviors. The principle of the biomarker approach is to analyze the organism’s responses to pollutant exposure. Therefore, the aims of the present study were to verify the suitability of biochemical responses shorter than a year to either show no variations in ages or high concentration in younger individuals. In addition, for chemical with half-lives longer than a year, the age percent difference increases with higher persistence. We defined that chemicals indicative of legacy exposure have a human half-life longer than one year and a long time lapse between the ban/phase-out and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age trend groups are explained by the product types in which the chemical is used and are not driven by belonging to a chemical family. The current study has defined criteria necessary to differentiate legacy exposure chemicals from currently exposed chemicals. Integrating generalized linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

643 Biomarkers for the assessment of water quality in tropical estuarine environments in northeast Brazil

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In attempt to define and measure the effects of pollutants in the aquatic ecosystem, biomarkers have attracted a great deal of interest. The principle of the biomarker approach is to analyze the organism’s responses to pollutant exposure. Therefore, the aims of the present study were to verify the suitability of biochemical responses of estuarine fish (Micropogonias furnieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as bioindicators to evaluate the environmental quality assessment in tropical estuaries of Maranhão State, Northeast Brazil. Thus, we evaluated biomarker of metal exposure as metallothionein-like proteins (MTLP), biomarker of organic exposure as 7-ethoxyresorufin-O-deethylase (EROD), and biomarkers of general effects like lipid peroxidation (LPO) and acetylcholinesterase (AChE). MTLP and LPO concentration were analyzed in copepod whole-body, crabs and fish hepatopancreas, while EROD activity were analyzed just in fish fillet and carcass. Samples were collected in three different sites along two estuaries (São Marcos Bay and São José Bay), in two seasons (dry season/August and rainy season/January) in three different years (August/2012, January/2013; August/2013 and January/2014). In both estuaries, a high degree of heterogeneity were observed in biomarkers response over the two years of study, with both spatial and temporal changes. However, analyzing all biomarkers studied, regardless of organisms and tissues, it is possible to observe at least two biomarkers alteration in both estuaries and season, reaching up to seven different biological responses in rainy seasons. The responses confirmed the initial expectation that both São José Bay and São Marcos Bay are subjected to the impact of the adjacent river basin drainage. In this context, biomarkers response were able to discriminate between the different sampling sites. Two biomarkers that are affecting the estuaries along different seasons and year as well as the effects on local species. Regard tests organists, estuarine fish (Micropogonias furnieri) showed to be more sensitive to environmental alterations, revealing most of the results obtained. Therefore, these results show that biomarkers is a promising tool for the assessment and monitoring of macro-tidal estuaries from tropical aquatic ecosystems impacted by anthropogenic activity.

644 Monitoring of priority substances in German freshwater fish of different age, size and trophic level


Monitoring of chemical substances under the Water Framework Directive (WFD) also requires the identification of certain priority substances (PS) in fish tissue. With the WFD daughter directive 2013/39/EU additional compounds were categorized as PS and for several of these environmental quality standards (EQSs) for biota have been introduced. This project was initiated to support the implementation of the WFD biota monitoring by comparative investigations and to promote an appropriate fish monitoring strategy which integrates all WFD monitoring requirements (e.g., compliance testing for human health- and secondary poisoning of wildlife-based EQS, comparability of monitoring data between sites and trend monitoring). To this end a dedicated sampling campaign was designed which covered six different freshwater sites. Fish were caught at sampling sites in the rivers Weser, Havel, Elbe and Moselle, in Lake Starnberg and a lagoon at the Baltic Sea. At each site three of the fish species were sampled that are listed in a German guidance document (RAKON IV.3): bream, chub, perch, roach and whitefish. During each sampling campaign it was tried to obtain twenty fish per species from two different age classes allowing multiple comparisons. Fish were dissected into fillets and carcasses, which were processed separately. Biometric data (e.g. fish size, weight, sex) were documented. Age was determined by examining otoliths. In attempt to define and measure the effects of pollutants in the aquatic environments in northern Canadian landscapes today. From 1948-2004 Giant Mine operated 5 km north of the City of Yellowknife, and contributed to the economic growth of one of Canada’s largest northern cities. Giant Mine roasted arsenopyrite ore at high temperatures to liberate gold, however a by-product of this roasting process was over 20000 tonnes of particulate arsenic trioxide, which was deposited to the surrounding landscape. The full extent of historic contamination in the area has yet to be characterized, although lakes within 17km of the roaster stack presently have elevated surface water arsenic concentrations. Here we use novel methods in paleoecotoxicology to characterize the full extent of contamination by analyzing 210Pb dated lake sediment cores collected from 18 lakes within a 30km radius of the roaster stack. Metal profile concentrations of arsenic, antimony, and lead track a peak in concentration during the height of mining operations, which decreases with distance from the roaster stack. Principal Component Analysis (PCA) of sedimentary metals show clustering of chemically similar lakes prior to mining, with divergence during operations, and little change occurring since after the mine closure. Microbial bioreporters were applied to assess the bioavailability of arsenic in porewater. This novel approach was developed based on the hypothesis that microbial bioreporters that are exposed to sediments corresponding to the time of operation. The results suggest that lakes in the region continue to show lingering contamination from past mining activities. Sedimentary analysis indicates a much larger radius of contamination than previously documented at the site. Future work examining multi-trophic level responses to contaminant exposure in dated sediments will improve our understanding of the impact of mining operations to the aquatic environments near Yellowknife, and will help predict the timing of ecosystem recovery.

Ecotoxicology of micro and nanoparticles: Mechanistic
646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms

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Microplastic pollution has become a serious environmental concern. Microplastics associated with wastewater treatment plant (WWTP) effluent have been found globally in marine and freshwater environments. Nevertheless, the concentration of microplastics discharged via wastewater after different treatment processes remains less understood. In this study, we identified microplastics in the wastewater effluent from three major WWTPs utilizing primary, secondary and tertiary treatment processes in Sydney, Australia. A novel validated sampler was designed for in situ collection of microplastics from wastewater effluent. The sampling method was combined with an efficient sample processing procedure to enhance the accurate detection of microplastics. The results indicated that primary effluent contained an average 1.5 microplastics/L. The amount of microplastics reduced to 0.6 microplastics/L after secondary treatment and 0.2 microplastics/L after tertiary treatment. Polyester fibres and polyethylene beads were predominantly detected in wastewater effluent, which possibly originate from synthetic clothing and cosmetic products, respectively. This suggests that WWTPs can act as a significant pathway to release microplastics to the aquatic environment, given the large volume of treated wastewater being discharged on daily basis. The effects associated with wastewater-based microplastics (e.g. fibres and beads) were thus investigated by exposing two freshwater organisms, a water flea (Ceriodaphnia dubia) and a sediment-dwelling midge larva (Chironomus tepperi), to microplastics in water and sediment, respectively, at concentrations within the range of environmentally realistic concentrations. A dose-dependent effect was observed after acute and chronic exposure of C. dubia to microplastics, with fibres showing more significant effects, though chronic effects were only observed at concentrations six times higher than the environmental levels. Further, exposure to an environmentally relevant concentration of microplastics adversely affected the survival, growth and emergence of C. tepperi. Size-dependent effects were observed with microplastics, with beads in the size range of 10-27 µm showing more pronounced effects. Our study demonstrates that microplastics are released into the environment by WWTPs and can have effects on freshwater organisms at concentrations within an order of magnitude of environmentally relevant levels.

647 What is in our plastic? In vitro toxicity of extracts from plastic products

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The ubiquitous abundance of plastic litter in aquatic ecosystems causes concern over their potential ecological and health impacts. So far, most toxicity studies focus on physical effects of plastic particles and chemical effects of sorbed environmental pollutants. The effects of chemicals intrinsically present in plastics, i.e. additives/reactive by-products, are largely unknown. Nevertheless, it is well established that these chemicals migrate from consumer products, thus representing a source of exposure to wildlife and humans. The aim of the current study is to investigate the in vitro toxicity of chemicals leaching from various plastic products and to characterize them using non-targeted chemical analysis. Different plastic types shall be ranked according to the toxicity of their leachates. Thirty-four plastic consumer products made of high-density polyethylene (HD/LDPE), polystyrene (PS), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polystyrene (PUR) or polyactic acid (PLA) were cut and extracted in a sonication-assisted, solvent-based procedure mimicking worst-case leaching. The extracts were tested for unspecific toxicity in the Microtox assay, for estrogenic and anti-androgenic activity in yeast-based reporter gene assays as well as for their potential to induce an oxidative stress response in the ARE32 assay. Two-thirds of the products leached chemicals triggering unspecific toxicity and one third of the samples induced an oxidative stress response. Nine plastic products released chemicals that were antiandrogenic and four slightly estrogenic. Overall, PVC and PUR extracts induced the highest toxicity in terms of potency and number of affected endpoints as almost all extracts triggered a high specific toxicity, oxidative stress and antioxidant response. In contrast, PET extracts were less toxic with only one sample inducing oxidative stress. Interestingly, all PLA extracts produced a very high unspecific toxicity. Effects of HDPE, LDPE, PP and PS extracts strongly depended on the product. Our findings indicate that extracts of plastic products induce a range of toxicological endpoints, including unspecific toxicity, oxidative stress and endocrine activity. Sorption studies of plastics under realistic conditions provided additional insights into the toxicological response. This demonstrates that a substantial part of plastic products are a potential source of exposure to toxic chemicals.

648 Microplastic size-dependent toxicity, oxidative stress induction, and multixenobiotic resistance (MXR) inhibition in the monogonont rotifer (Brachionus koreanaus)

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Plastic debris in marine environments has attracted great concern in these days due to their world-wide distribution, persistence, and increasing amount of small-sized plastic products due to degradation of larger plastic debris. However, little is known about their impacts on marine organisms, particularly at the molecular level. Here the dependence of microplastic toxicity to the monogonont rotifer (Brachionus koreanaus) on particle size was investigated by studying the ingestion and egestion of four microplastics recently labeled 0.05, 0.5, 1.0, and 6.0 µm polystyrene microbeads. Exposure to polystyrene microbeads led to significant size-dependent negative effects on growth rate, reproduction, and lifespan. In consistent, transmission electron microscope (TEM) analysis have revealed cellular damages in the rotifer B. koreanaus exposed to 0.05 µm microbeads, indicating nano-sized microbeads would cause more serious impacts on aquatic organisms. To further explore the defense mechanisms in response to different sizes of microbeads, the activities of several antioxidant-related enzymes and phosphorylation statuses of mitogen-activated protein kinases (MAPKs) were determined. Particularly, 0.05 µm microbeads have inhibited multixenobiotic resistance (MXR), resulting increase of sensitivity of rotifers to environmental pollutants. Our study provides a better understanding of molecular responses in the rotifer B. koreanaus in response to microplastics and their potential impacts on the aquatic ecosystem.

649 Sorption of model pollutants on microplastics and toxicity assessment using early life stage of zebrafish (Danio rerio)

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The growing production of plastics increases the amount of plastic debris in aquatic ecosystems. Their degradation lead to the emission of microplastics (MPs) when their size is between 1-5000 µm. MPs can result from runoff and degradation (degradation or weathering) of macroplastics or from the fragmentation of microplastics in cosmetics, industries and domestic sources. Virgin plastic polymers are, in principle, biologically inert and thus non-toxic. However, plastic production includes additives such as plasticizers, colorants or fire retardants that can be toxic. In addition to the potential toxicity caused by additives, MPs offer surfaces where hydrophobic pollutants can be adsorbed, including persistent organic pollutants (POPs). In marine environments, such chemicals are found at high concentrations in the surface layer, where low-density microplastics are most abundant. Indeed, these small particles can act as vectors and carriers for a wide range of pollutants and be ingested directly by organisms, causing chronic physical and/or toxicological effects. While accumulation of MPs in aquatic ecosystems is a growing concern in society, the toxicity of MPs for wildlife and the processes of sorption of organic pollutants onto MPs are very complex and poorly understood. Therefore, objectives of the present study were to investigate the sorption kinetics of two model pollutants to LDPE (Low Density PolyEthylene) microparticles for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of FFOs, but affects BaP sorption to the particles. The sorption of BaP was increasing during the first 7 days, while for the remaining 3 months of the experiment, the concentration of BaP absorbed by the MPs was constantly decreased. On the toxicity aspects, no acute toxic effects were observed, using FET test with microplastics particles (virgin or spiked). No differences were found regarding sub-lethal endpoints (genotoxicity, phototaxis, response in larvae) and EROD activity between the control group and fish exposed to virgin MPs, spiked MPs or control adducts. Results showed that MPs can be vectors of pollutants which sorbed at the surface over time. The toxicity of MPs as carriers of POPs cannot be demonstrated with 96h of exposure to LDPE microparticles. Experiments are currently being done to test the toxicity of MPs.

650 Comparative role of microalgae and microplastics in the effects of chlorpyrifos on molecular biomarkers in marine mussels

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Plastic particles within the microns range (microplastics, MP) are increasingly present in marine ecosystems. One of the most concerning aspects of MP in marine
habitats is that they might act as vectors of pollutants to marine organisms, since hydrophobic organic contaminants with low water solubility tend to concentrate on the surface of these particles. In this study we have compared the role of polyethylene MPs and microalgae (MA) of similar size, as vectors of the organophosphorous insecticide chlorpyrifos (CPF) to *Mytilus galloprovincialis* main mussel. With that aim, CPF pre-exposed MP and MA were offered to the marine mussels *Mytilus galloprovincialis* in a bioassay and the bioaccumulation and toxicity were measured. AcH activity in digestive gland and gills was significantly inhibited at all CPF treatments, disregarding exposure time. Levels of GST activity in the digestive gland in the three CPF treatments (CPF, MA+CPF and MP+CPF) after 7 days exposure were significantly higher than levels in treatments without CPF. However, after 21 days exposure, GST activity in the controls significantly increased, and differences with controls disappeared. For GST in gills, a significant increase in activity was observed in the MP, CPF and MA-CPF treatments after 7 days, compared to the MA control. When the nine biomarkers recorded were combined using the Integrated Biomarker Response (IBR) index a similar response in the three CPF treatments is initially observed (7 d), but after 21 d an enhanced response in observed in the MA+CPF and MP+CPF treatments only. In conclusion, AcH enzyme inhibition was similar in all CPF treatments disregarding the presence of particles. However, both MP and MA particles in CPF-exposed mussels produced in the long term an increase in biomarker response compared to waterborne exposure. Therefore MP seem to play a similar role than natural organic particles as vectors of organics to marine organisms.

651 Poster spotlight: TH001, TH002, TH003

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (II)

652 Dissipation of the carcinogenic ptaquiloside in water resources

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Ptaquiloside (PTA) is a natural carcinogen found in a number of ferns Worldwide. The distribution and occurrence of PTA is best known from the Bracken ferns (genus *Pteridium*) which are classified in Group 2B (possibly carcinogenic to humans) by WHO/IARC. The content of PTA in Bracken is highly variable (up to 15% w/w). PTA is readily leached from Bracken stands from where it can enter the soil, waterways or potentially contaminate groundwater. Several records of PTA contamination of surface water and upper groundwater exist from Denmark and Great Britain. The fate of PTA in surface and ground water has not been studied.

Under sterile conditions, dissipation (= hydrolysis) of PTA in aqueous solution follows classical first order kinetics: \( k_{\text{obs}} = k_{\text{H}^+} + k_{\text{H}^+} \) for PTA in solution as follows classical first order kinetics: \( k_{\text{obs}} = k_{\text{H}^+} \) for PTA in solution and \( k_{\text{obs}} = k_{\text{H}^+} + k_{\text{H}^+} \) for PTA in aqueous solution. The rate constants are: \( k_{\text{H}^+} = 25.7 \pm 1.0 \text{ M}^{-1} \text{ h}^{-1} \) and \( k_{\text{H}^+} = 6.5 \pm 6.0 \text{ M}^{-1} \text{ h}^{-1} \) for \( k_{\text{H}^+} = 6.5 \pm 6.0 \text{ M}^{-1} \text{ h}^{-1} \) and \( k_{\text{H}^+} = 6.5 \pm 6.0 \text{ M}^{-1} \text{ h}^{-1} \) for \( k_{\text{H}^+} = 6.5 \pm 6.0 \text{ M}^{-1} \text{ h}^{-1} \). The activation energy for PTA hydrolysis at pH 4.6 is approx. 75 kJ mol\(^{-1}\). Hence, hydrolysis is a function of both pH and temperature. The temperature of this investigation was 25°C. When first investigated in near-neutral conditions using 10 different surface and groundwater bodies from Denmark and Sweden, and to compare the degradation kinetics with the existing model for hydrolysis. Degradation was fast in natural non-sterilised lake waters with half-lives from 5 to 25 h. All PTA were degraded within 200 h. Sterile controls had no degradation. Winter samples exhibited slower degradation (half-lives up to 100 h). Sterile samples followed the existing model for hydrolysis closely, i.e. no degradation at neutral pH. PTA persist considerably longer in groundwater. Half-lives in groundwater ranged from 7 to approx. 50 days with fastest degradation in alkaline waters. The existing model for hydrolysis could generally predict the rate of degradation in groundwater. However, the model did not perform well at low or high pH. Pterosin B was formed as the end product by hydrolysis in the tested groundwater at a molar ratio of approx. 1:1 for PTA:Pterosin B. However, under weak acid conditions, only approx. 10% of the potential pterosin B were formed. The risk of leaching from Bracken stands and contamination of surface waters is highest during the winter season. PTA has the potential of contaminating mainly shallow aquifers as the compound can persist for up to several months in contact with groundwater. The risk is expected to be highest at near-neutral conditions in aquifers.

653 On-line detection of algal toxins in sea water

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Natural toxins produced by plants, algae and microorganisms represent a serious concern for public health. Current detection methods need expensive equipment, trained personnel and complex protocols. In particular, the determination of marine biocones, released as a consequence of toxic algae blooms, is performed offline on fish / shellfish homogenates rather than on-line, resulting not appropriate for monitoring programs that require real-time warnings like in specific situations relevant for public health, such as bathing sites and aquaculture plants. Thus, there is a special need for on-line, continuous, rapid and sensitive field tests. To fill this gap, if it was developed an assay for detecting rapid interactions between a microorganism (linked-immuno-magnetic complex) and a microorganism assay for the detection of Domoic Acid, Okadaic Acid and in seawater. The assay is based on the fact that, in the presence of the target toxin, competition occurs and consequently the color production decreases proportionally to the toxin concentration. This assay takes advantage of antibodies specific for a wide range of toxins, the fact that it is integrated within a fully automated PC-controlled on-line analyzer based on the micro Loop Flow Reactor technology able to host three immunosensor sub-modules. Specific volumes of reagents were injected to a flow cell, equipped with a heater, a magnet and an optical group. Because most of the reagents needed to be kept at 4°C, a Pelletier refrigerated compartment was designed and incorporated in the instrument. Laboratory measurements were executed to validate the prototype efficiency to detect sub-ppb concentrations of the algal toxins.

The obtained calibration lines were consistent with the strict requirements limiting the presence of the toxins in environmental waters. On-line suitability was demonstrated by a field installation on a floating platform in the port of La Spezia, Italy, for daily monitoring of real marine water samples, in which the instrument was integrated together with the delivered real-time data.

654 A decade of chemical studies on Oostrea. What’s left?

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Over the last decade massive blooms of the benthic dinoflagellate *Ostreopsis cf. ovata*, once confined to tropical and subtropical areas, have occurred in more temperate regions worldwide including the Mediterranean Sea. Concurrently, negative impacts on human health mainly due to inhalation of toxic aerosols and/or skin irritation were observed together with death of marine invertebrates and fish. When first investigated in near-neutral conditions using 10 different surface and groundwater bodies from Denmark and Sweden, and to compare the degradation kinetics with the existing model for hydrolysis. Degradation was fast in natural non-sterilised lake waters with half-lives from 5 to 25 h. All PTA were degraded within 200 h. Sterile controls had no degradation. Winter samples exhibited slower degradation (half-lives up to 100 h). Sterile samples followed the existing model for hydrolysis closely, i.e. no degradation at neutral pH. PTA persist considerably longer in groundwater. Half-lives in groundwater ranged from 7 to approx. 50 days with fastest degradation in alkaline waters. The existing model for hydrolysis could generally predict the rate of degradation in groundwater. However, the model did not perform well at low or high pH. Pterosin B was formed as the end product by hydrolysis in the tested groundwater at a molar ratio of approx. 1:1 for PTA:Pterosin B. However, under weak acid conditions, only approx. 10% of the potential pterosin B were formed. The risk of leaching from Bracken stands and contamination of surface waters is highest during the winter season. PTA has the potential of contaminating mainly shallow aquifers as the compound can persist for up to several months in contact with groundwater. The risk is expected to be highest at near-neutral conditions in aquifers.

655 Untangling the geosmin appearance in a Mediterranean river: relationship of geosmin concentration and physicochemical parameters over a year

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According to the General Food Law, the European Food Safety Authority (EFSA) is required to identify emerging risks in the fields within its mission. EFSA has developed a methodological framework for identification of emerging risk, starting from a preliminary identification of priority emerging issues through knowledge networking activities. The long term anticipation of emerging risks includes the identification of drivers. Drivers are the underlying natural or human-induced factors that directly or indirectly cause emerging risks. Climate change is recognised as a critical driver and its impact on the occurrence and toxicity producing phytoplankton, bacteria and pathogenic viruses and on other food safety domains was demonstrated. With the aim of further exploring tools to identify and prioritise emerging risks, EFSA initiated a project focusing on climate change as a driver of emerging risks for food and feed safety, including plant and animal health. A knowledge discussion group involving the major institutions involved with climate change has been created. The group will define criteria to identify relevant sub-drivers (eg. rising and more fluctuating temperatures, changing precipitation patterns, increase in natural disasters etc), the issues relevant to different food safety domains including plant health and animal health, and to develop a harmonised and transparent scoring system applicable to the identified emerging issues in order to prioritise future research and risk assessment activities.

Advances in evaluating and regulating endocrine disruptors

658 Hazard identification of endocrine disrupting properties of pesticides on non-target organisms: state of the art and future perspectives

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According to the Regulation (EU) no 283/2013, setting out the data requirements for active substances, in accordance with Regulation (EC) no 1107/2009 concerning the placing of plant protection products on the market, the endocrine disrupting properties of pesticides should always be assessed, as substance identified as an endocrine disruptor should not be approved. Most of the current knowledge about endocrine disruption is related to EATS (Estrogen, Androgen, Thyroid and Steroidogenesis) modalities in vertebrate organisms i.e. there is a good mechanistic understanding on how those modalities can lead to an adverse effects. The OECD conceptual framework and the OECD 150 provide an overview of the existing assays for the endocrine disruptors (ED) hazard identification and guidance on how to interpret the results of those tests. A suitable testing strategy which allows the identification of ED properties of pesticides through EATS modalities is available for some taxa of non-target organisms (i.e. fish and amphibians). The analysis confirmed that the available test methods and knowledge on birds’ endocrinology do not allow a full ED assessment although they can provide supportive information. In the case of reptiles, appropriate standard test methods are completely missing. In some circumstances, extrapolation between taxa could be scientifically supported. However, consideration should be given for taxon-specific differences. Extrapolation between mammals and amphibians regarding the ED hazard identification through the thyroidal modulation has been investigated in the past. A similar analyses has not been done for EAS modalities, however, in some cases extrapolation among oviparous vertebrates is scientifically justified e.g. in the case of the steroidogenesis pathway leading to reproductive dysfunctions (more specific for extragines). The main scope of this work is to present a critical overview of the available standardised test methodology for the ED assessment of non-target organisms, including consideration on the extrapolation between taxa. In addition, possible future perspective and research needs are discussed.

659 Contaminants of emerging concern in the North American Great Lakes: Evidence of reproductive disruption from field and laboratory studies

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Analysis of nearly 500 surface water samples collected as part of the Great Lakes Restoration Initiative at 54 sites in tributaries of the North American Great Lakes Watershed confirmed the ubiquitous presence of Contaminants of Emerging Concerns (CECs) in anthropogenically impacted aquatic environments. Still the most important scientific gaps and research needs are highlighted.
plasma and liver cells exhibited toxic stress response. Canonical correspondence analyses revealed that concurrent with indicators of toxic stress, biomarkers of reproductive potential declined. To further examine the population level consequences, fathead minnows (Pimephales promelas) were exposed in the laboratory for three generations to the empirically derived urban CEC mixture at three environmentally relevant concentrations. Mixtures at environmentally modified conditions enhanced fecundity in the F2 and 3rd generation. While higher mixture concentrations resulted in declining fecundity. Taken together, this integrated series of studies indicate that CECs in Great Lakes tributaries may impact fish population health and sustainability.

660 AOP-informed assessment of Endocrine Disruption in freshwater crustaceans K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment; M. Cronin, Liverpool John Moores University; T. Evenhuis, Norwegian School of Veterinary Science; L. Evenson, The Arctic University of Norway; F. Falciani, University of Liverpool; T. Iuchi, YOKohama City University / Molecular Environmental Endocrinology; C. LaOne, U.S. EPA / Mid Continent Ecology Division; Y. Li, NIVA Norwegian Institute for Water Research; M. Menzies, University of Vermont. School of Pharmacy and Biomolecular Sciences; E. Perkins, US Army Corps of Engineers ERDC; T. Runderberget, Norwegian Institute for Water Research; B. Salbu, Norwegian University of Life Sciences; I. Sylte, The Arctic University of Norway / Department of Medical Biology; D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; N. Vinas, Mississippi State University / Biomarker Research and Dehazemix Consortium; N. Vinas, Norwegian Institute for Water Research / Ecotoxicology and Risk Management

A number of xenobiotics have the potential to interfere with the endocrine system of animals and may perturb vital endocrine processes to a degree causing an adverse effect (outcome) on ecologically relevant endpoints such as growth, development and reproduction. These endocrine disrupting (ED) effects have been well characterised in aquatic vertebrates and mammals due to a well-defined endocrine system and substantial research effort in the last decades, but knowledge on ED effects in a larger range of species are still poorly characterized. Lack of knowledge on ED effects in invertebrates is currently a major limiting factor to properly perform risk assessment of endocrine disrupting chemicals (EDCs) across taxa. The present project has focussed on developing Adverse Outcome Pathways (AOPs) for EDCs in aquatic crustaceans, and applying these to assess the hazard and risk of ecologically relevant complex mixtures of pollutants. Although several ED mechanisms have been proposed to be of relevance for crustaceans, perturbations of endocrine processes related to chemical interactions with the ecdysone receptor (EGR) and the Juvenile Hormone (methyl farnesoate) receptor (MFR) have been identified to be of particular concern. The present paper focus on the application of AOPs to (1) develop linkage between endocrine mechanisms and adverse outcomes, (2) identify knowledge gaps and inform testing strategies, (3) identify sensitive species/taxa, (4) identify likely scenarios of toxic endpoints suitable for Integrated Approaches for Testing and Assessment, (IATA), (5) identify potential EDCs and (6) practical implementation of AOPs for risk assessment based on environmentally relevant exposure scenarios. Acknowledgement - Funding from RCN-221455 A_Adverse Outcome Pathways for Endocrine Disruption in Daphnia magna, a conceptual approach for mechanistically-based Risk assessment (www.niva.no/edrisk); RCN-268294 “Cumulative hazard and risk assessment of complex mixtures and multiple stressors (www.niva.no/mixrisk)” and EU-FFP project SOLUTIONS (http://www.solutions-project.eu/project/).

661 Assessing impacts of place-based mixtures of emerging contaminants on endocrine activity and adverse outcome pathways: comparisons of different life stages R. Klug, University of Wisconsin-Milwaukee / School of Freshwater Sciences; J. Crago, Texas Tech University/TIEHH / Environmental Toxicology The Institute of Environmental and Human Health TIEHH

Emerging contaminants often appear as mixtures of differing concentrations across a landscape. Traditional toxicological assays as well as receptor binding assays that examine the impact of single chemicals or mixtures do not adequately detect all EDC mixtures and do not describe the collective impact of mixtures as there can be cross-talk among molecular pathways. Using place-based mixture concentrations of emerging contaminants in combination with multiple molecular initiating events from adverse outcome pathways can help to identify potential hotspots of potential environmental impact that cross multiple mechanisms of action. This talk will discuss the use of transcriptomics to modify the OECD fish embryo acute test (FET) and chronic exposures to juvenile and adults fish are being used to examine EDC pathway related disruption. Examples discussed will include several experiments using exposure mixtures representing those measured in several locations in Lake Michigan.

662 Interference of hepatotoxicity with endocrine activity in zebrafish (Danio rerio) L.A. Baumann, University of Heidelberg / Aquatic Ecology and Toxicology; H. Holbeck, University of Southern Denmark / Biology; L. Weltje, BASF SE / Crop Protection; Ecotoxicology; H. Schmidt-Posthaus, University of Bern / Institute of Animal Pathology; H. Segner, University of Bern / Centre for Fish and Wildlife Health; T. Braunbeck, University of Heidelberg / Centre for Organismal Studies Vitellogenin (VTG), a well-established biomarker for the diagnosis of endocrine activity in fish, is used in the OECD test guidelines 229, 230 and 234. A reduction of VTG production (mainly in females) is usually an indication of androgenic or anti-estrone activity, whereas an increase of VTG (mainly in males) is associated with estrogenic activity. However, the synthesis of VTG may not only be modified by typical endocrine-related pathways, but also through non-endocrine-mediated processes. In particular, hepatotoxicity, i.e. toxicant-induced impairment of liver structure and function, can influence VTG as a biomarker, since it is synthesized in the liver. Changes in VTG caused by non-endocrine hepatotoxicity in a screening assay would unnecessarily trigger very labor-, animal- and cost-intensive higher tier testing (e.g. a fish life cycle test). Therefore, an intuitive understanding of the interplay between primary endocrine-related and non-endocrine-related pathways influencing VTG production is crucial for the avoidance of false diagnoses. The present study is driven by the hypothesis that hepatotoxicity may interfere with VTG synthesis in the liver / ovary / testis of fish. Thus, we investigated the effects of two well-known hepatotoxicants, acetaminophen (APAP) and isoniazid (INZ), on zebrafish (Danio rerio) in a 21-day flow-through exposure test according to OECD guideline 230. Various hepatotoxicity- and endocrine system-related endpoints were recorded: - mRNA expression of different endocrine-related (vtg1, vtg3 and esr1) and hepatotoxicity-related marker genes (fabp10a, apoal, cyp2k19 and cyc1) in the liver; - hyaluronic acid (a biomarker for liver toxicity) levels in head/tail homogenates; - liver histology and ultrastructure; Both APAP and INZ had different effects on exposed fish. While APAP did not cause any histopathological alterations in the liver, INZ significantly induced hepatocyte degeneration. VTG levels in APAP-exposed females were elevated, while no effect was observed in INZ-exposed fish. Likewise, grown testes were more frequently observed between both compounds and indicate that both did interact with different endocrine- and hepatotoxicity-related pathways. The results from both studies will further be evaluated with respect to their potential for the development of an adverse outcome pathway (AOP) for interference of hepatotoxicity with the VTG response in fish.

663 Single Pulse Exposure of Different Life Stages of Zebrafish to the Selective Estrogen Receptor Modulator Tamoxifen Citrate S. Kroesen, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; C. Schaefers, Fraunhofer-Institut / Ecotoxicology, E. Bruns, Bayer AG, Division Bayer CropScience; T. Eilbracht, M. Teigel, Fraunhofer IME / Ecotoxicology

The discussion about the regulation of endocrine disruptors (EDs) is on-going between groups of scientists, authorities and stakeholders. Especially dose-dependency, low dose effects and effect thresholds are still under debate. To address parts of these questions, a static life-cycle test with zebrafish (D. rerio) has been performed to examine if a pulse exposure to an ED might generate - distinguishable effects and the establishment of a dose-response relationship is possible. The results will be used for a comparison with available data originating from a flow-through study with TC in zebrafish. A water-sediment system has been set up to expose different life-stages (group A: 40 eggs, group B: 20 juveniles, group C: 16 adults) to a known ED, Tamoxifen citrate (TC). Observed endpoints included early-life stage mortality and reproduction as well as adult growth, sex ratio, vitellogenin levels and F0-generation early-life stage. Four concentrations of TC were applied as a pulse in three replicates each, ranging from 125 µg/L to 1000 µg/L (spacing factor 2). Four controls replicates were included. Mortalities occurred in all developmental stages (groups A to C), especially in high concentrations (500 µg/L, 1000 µg/L). In sexually mature fish (group C) mortality was higher in males. A decline in fertility could be observed for group C, possibly related to the higher male mortality. Total egg numbers appeared unaffected. The results were mirrored for fish introduced as juveniles (group B): While fertility rates were not influenced negatively, fecundity was lower in remaining concentrations (125 µg/L, 250 µg/L). Changes in egg morphology were noticed shortly after exposure to TC (group C). Consequently, F0 fish exposed to TC showed a dose-dependent decrease in survival rates and growth. Although reproduction data are difficult to be attributed to endocrine activity, an influence on the endocrine system of the test animals seems apparent. Particularly sex specific effects in F0-fish as well as an impaired early life-stage in F1-fish are of highest interest. Further data on vitellogenin and reproduction will help clarifying pending questions. Additionally, several other accessible datasets from zebrafish studies featuring paired pulsed and flow-through exposures of EDs with diverse dissipation times will be integrated in the concluding assessment. The final objective is to deduce possible effect thresholds based on internal concentrations.

BIER is good for you: How biotransformation and elimination rate information can improve chemical assessments
A Tiered Approach for Screening Chemicals for Biomagnification Potential in Humans

A. Sangion, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA); J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; P. Gramatica, E. Papa, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA)

Bioaccumulation is a process in which the chemical concentration in an organism exceeds the concentration in the respiratory medium, the diet or both and is an integral aspect of hazard and risk assessment. Strong correlations between partitioning properties such as the octanol-water partition coefficient (Kow) and the octanol-air partition coefficient (Koa) and the bioaccumulation potential of water-respiring and air-breathing organisms have led to Kow and Koa being the primary screening criteria for bioaccumulation assessment. However, primary biotransformation rate data for these chemicals and chemicals used in consumer goods. Tiers that do not consider biotransformation (1, 2 and 3) estimate a high percentage of chemicals with BMF greater than 1 (i.e. about 95%, 95% and 93%). In particular, in Tier 2 and in Tier 3, the introduction of the biotic partition coefficient kstoLipW, kMemLipW and kProtW and the in vivo acute toxicity at pH 7.4 reduces the BMF estimate for some chemicals, but in general the effects are limited. In Tier 4, where the introduction of the HLa has a high impact on the scoring results, strongly reducing the BMF estimate to <1 for most of the compounds (i.e. about 90%). This shows how models based only on partition coefficients are not sufficient to describe and address the bioaccumulation and biomagnification processes, and can lead to overly conservative estimates (“false positives”). Moreover the study highlights the key role of biotransformation in bioaccumulation assessment for air-breathing organisms and highlights the need for reliable data on biotransformation to effectively categorize chemicals for hazard.

Critical Evaluation of a Human In Vitro Biotransformation Rate Database: Case Study of Seven Chemicals

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Despite the fundamental value of biotransformation rate information, relatively few datasets are publicly available and generally the effects are limited. In Tier 4, where the introduction of the HLa has a high impact on the scoring results, strongly reducing the BMF estimate to <1 for most of the compounds (i.e. about 90%). This shows how models based only on partition coefficients are not sufficient to describe and address the bioaccumulation and biomagnification processes, and can lead to overly conservative estimates (“false positives”). Moreover the study highlights the key role of biotransformation in bioaccumulation assessment for air-breathing organisms and highlights the need for reliable data on biotransformation to effectively categorize chemicals for hazard.

Diuron is a commonly used phenylamide herbicide which acts by interrupting the photosynthetic electron transport chain. Like other phenylamide herbicides diuron is bio-transformed to 3,4-dichloroaniline (3,4-DCA) which occurs in plants, the liver of vertebrates and in soil. Fish embryos do not possess the same metabolic potential as adult fish. It was not determined so far if different embryo stages differ regarding their biokinetics or if 3,4-DCA and metabolites come from parent compounds or metabolites. We addressed the following questions: What are rates of uptake and elimination of diuron and 3,4-DCA in different zebrafish embryo stages? Is diuron biotransformed by the embryo via which metabolic pathway? Does the embryo`s chorion form a barrier for diuron and 3,4-DCA mitigating the compounds’ toxicities? Information on these aspects is valuable for the understanding of the toxicity of phenylamide herbicides to fish embryos. For determining tissue concentrations after different times of exposure, freshly fertilized zebrafish eggs were exposed to the EC20, i.e., for diuron 2.86 mg/L and for 3,4-DCA 1.41 mg/L, pools of 7 embryos were shock-frozen at 13 time points from 1.5 to 120 hours post fertilization (hpf). The test compounds were extracted from the embryo tissue with MeOH/H2O and quantified using liquid chromatography coupled to tandem mass spectrometry (LC/MS/MS). Depuration of test chemicals from the embryo tissue was examined in five different developmental stages of embryos that upon exposure to chemicals were transferred to clean medium and then sampled after 0.5, 1.5, 3.6 and 24 hrs. The tissue concentrations for diuron reached T50 for 48 hpf, T50 for 3,4-DCA was between 8 and 24 hpf. Based on the data for internal concentrations upon different exposure times uptake and elimination rate constants (k, k) were determined. Both elimination rates and residual of initial concentration after 24 hrs. of depuration differed between embryo stages. The search for possible metabolites showed that 3,4-DCA was transformed into 3,4-dichloroacetanilide in the embryo and two products of N-demethylation of diuron were found. This confirms that both phase I and phase II metabolic pathways were active. The values enzymes are active from the first hours of embryo development and pinpoints to the biotransformation capability of the zebrafish embryo at this early stage.

A application of a generic fish PBTK model for binary mixtures of chemicals

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The integration of mechanistic approaches in Environmental risk assessment requires the integration of processes to move towards estimating internal dose from exposure or environmental concentrations (external dose) to predict toxicity in each taxa or the whole ecosystem. In this context, the overall objective of this work is to develop models to integrate TK data for environmental risk assessment of single and multiple chemicals. Three steps were defined to fulfil this objective: (i) Data collection of biological, physiologically, and toxicological variables to calibrate and develop PBTK models, (ii) Development of PBTK models for environmental risk
assessment of single chemicals, (iii) Development of PBTK models for environmental risk assessment of multiple chemicals. Generic PBTK models for single compounds in rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), stickleback (*Gasterosteus aculeatus*) and zebrafish (*Danio rerio*) have been developed. Physiological description and parameters proposed by Nichols et al. [1] were updated by an extensive literature search. New mathematical functions were proposed to integrate the main factors influencing the toxicokinetics (water temperature, growth dilution, reproduction cycle, …). Default values for compound-specific parameters were estimated by QSAR models based on hydrobicity [2, 3]. An optional interaction terms was added to the mixture PBTK models for metabolic interactions such as competitive inhibition. Two case studies were selected based on availability of toxicokinetic (TK) and toxicodynamic (TD) data for single compounds and for mixtures. In the first case study, the interaction between melamine and cyanuric acid was studied and in a second case study, the interaction between chlorpyrifos and permethrin was modelled. The models developed enable to model interactions that are observed between exposure concentrations and final effects. The QSAR estimations of certain compound-specific parameters can compensate for the lack of data in fish. Extrapolation from one species to another with the various models developed can also help bridge gaps. [1] Nichols et al. 1990. Toxicol Appl Pharmacol 106:433-447. [2] Bertelsen et al. 1998. Environ Toxicol Chem 17:1447-1455. [3] Nichols et al. 2006. Aquat Toxicol 78:74-90.

669 Application of Aqueous and Dietary In-Vivo Bioaccumulation Tests to Determine Biotransformation Rates, Elimination Rates and other Bioaccumulation Metrics

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Bioaccumulation assessment is quickly evolving to respond to the need to conduct bioaccumulation assessment faster, better, cheaper while reducing animal use. In this presentation, we present novel methods for conducting both aqueous and dietary bioaccumulation tests that provide more information on bioaccumulation than currently used methods while also reducing animal use, effort and costs. Stream-lined aqueous bioconcentration test designs and dietary bioaccumulation studies following OECD 305 test guidelines are shown and discussed. A key element of the novel methods is the use of reference chemicals. In addition to experimental methods, we also present computational methods for deriving biotransformation rate constants, elimination rate constants and other bioaccumulation metrics with their associated error from the results of bioaccumulation tests. This involves an Excel worksheet, referred to as ADME calculator, that is specifically developed to interpret the results from aqueous and dietary bioaccumulation tests in terms of Absorption, Distribution, Metabolism and Excretion (ADME) rates including somatic and intestinal biotransformation rate constants, elimination rate constants, BCF and other bioaccumulation metrics. We further demonstrate that the application of reference chemicals can help to develop a full mass balance of the internal distribution of test chemicals in fish in the test and in the field under environment-specific exposure conditions. The application of the test results for determining exposure pathways of the test chemical under field conditions is illustrated. We conclude that bioaccumulation tests can become more effective in developing bioaccumulation profiles of chemicals when including reference chemicals.
Poster Abstracts

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (P)

MO001
An in-situ amphibian metamorphosis assay to evaluate oil spill-related toxicity in receiving freshwater systems
R. Krohn, University of Calgary / Dept. of Ecosystem & Public Health, Faculty of Veterinary Medicine; J. Muscatoello, Lorax Environmental Services Ltd; J. Smits, University of Calgary / Ecosystem & Public Health Faculty of Veterinary Medicine

Divided Amphibian Life Cycles

Zebrafish embryos were exposed to a variety of oil spills in different environmental conditions using zebrafish embryos. The ambi

Assessment of the biological impact of using chemical dispersants to remediate oil spills in different environmental conditions using zebrafish embryos

Oil spills are a global concern due to their capacity to affect wide areas of the ocean and the biota therein. The reproductive strategy of the subsequent restoration of the ecosystem. Early life stages of fish are especially sensitive to oil spills as they are unable to flee the area and lack mature detoxification systems to withstand the chemicals. They also represent a direct link to population consequences and resilience. The addition of chemical dispersants can facilitate the dissolution of some chemicals present in the oil and make them more bioavailable. In addition, some chemical dispersants have been proven to be toxic themselves. The impact of crude oil on a specific ecosystem and its recovery potential are determined by the biotic and abiotic elements of the ecosystem such as species composition, temperature, oxygen level and salinity. At low temperatures the persistence of hydrocarbons in the environment increases. Based on the standard OECD test with zebrafish embryos, we have tested the toxicity of the chemical dispersant FINASOL OSR52 and of the water accommodated fraction of a naphtenic North Sea crude oil produced with dispersant (WAFW300) or without dispersant (WAFW300) at different conditions of temperature and salinity. For WAF produced in marine water, polydimethylsiloxane (PDMS) sheets were incubated in the WAFW300 and WAFW300D and then used as passive dosers. Exposure to the dispersant caused 100% of mortality at concentrations ≤50 mg/L. Increased prevalence of malformations was observed at concentrations of 50 and 100 mg/L. Results from a 2018 field season with the experimental approach

MO002
APPLICABILITY OF RISK BASED, TIERED ASSESSMENT OF DISCHARGES IN NIGERIAN SHALLOW OFFSHORE ENVIRONMENT
M.G. Smid, Shell International; O. Anako, SPDC Nigeria Ltd

The pursuit of excellence in managing risks associated with produced water discharges has led to continuous innovation of internationally acceptable risks assessment tools for determining the risks associated with produced water discharges. This study utilized a structured approach for the assessment of potential risks from water discharges. At the centre of this structure is a comparative analysis of predicted environmental concentrations (PECs) of chemicals and effluents to predicted no effect concentrations (PNECs) of environmental receptors. However, the determination of the likelihood and severity of effects is complicated and based on an integrated evaluation of several Lines of Evidence (LOEs). This study utilized risk-based assessment tools from Shell’s tiered assessment framework for discharges. This framework was developed based on international good practice and includes screening tools that allow for a rapid assessment of discharge properties and associated risks like SPME-GC and Microtox. In addition higher tier tools were applied like two way GCxGC, PETROTOX modelling and several levels of plume dispersion assessment. The objective is to determine the applicability of risk-based practice to the specific shallow offshore discharge, with possible replication to other shallow offshore or near shore discharges in Nigeria. It also assessed if discharges would be acceptable from an international perspective and whether indeed the risks are tolerable and as low as reasonably practicable (ALARP). Results of the assessment indicate that at oil in water levels at or below 25 mg/L there is low concern related to the environmental risk of the hydrocarbons in the PW discharge. Phenols and BTX came up as the highest risk contributors but Tier-2 modelling indicated that these substances quickly dissipate after discharge. PETROTOX modelling showed that the hydrocarbon fraction in the PW could not fully explain the observed PW toxicity. This led to a recommendation for qualification and registration of offshore chemicals and identified a need for the alignment considerations of future Biological Monitoring programs to international protocols such as OECD and ISO. Application of smart screening tools (Tier-1) for frequent PBT monitoring to address variability and for tuning and focusing the larger Tier-2 and 3 assessments.

MO003
Assessment of the biological impact of using chemical dispersants to remediate oil spills in different environmental conditions using zebrafish embryos

MO006 Bioaccumulation of Sulfur and Nitrogen Containing Hydrocarbons in Petroleum Substances

T. Parkerton, ExxonMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; A. Bleich, ExxonMobil Biomedical Sciences Inc; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; C. C. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; A. D. Redman, ExxonMobil Biomedical Sciences / Toxicology and Environment Science Division; M. Lampi, ExxonMobil Biomedical Sciences. A recent analytical effort to characterize the composition of petroleum substances from different categories indicated that a variety of sulfur and nitrogen heterocyclic compounds and bioactive compounds are present in the range of sulfur and nitrogen heterocyclic compounds. These compounds will be used for monitoring of these estuarine systems, especially Snape Estuarine Complex, which is under a rapid urbanization and industrialization process.

MO007 Biochemical biomarkers and histopathology in juvenile Solea senegalensis for early warning assessment of marine ecosystem health

T. Briandieu, University of the Basque country UPV/EHU; A. Alves Dos Santos, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; G. Guerrero Limón, University of the Basque country UPV/EHU; I. Marigomez, Euskal Herriko Unibertsitatea / Zoology & Animal Cell Biology (Sci & Tech Fac); I. Zorita, FUNDAEZON AZT; M. Soto, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIE; G. Guerrero Limón, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE Human originated contaminants can appear diluted in estuarine and marine waters or accumulate in sediments. Chemical analysis provides key data on toxicant levels but gives limited inputs on their potential biological effects. The combination of biological responses with chemical data is essential to improve the assessment of environmental pollution. In this context, the use of benthic species for the assessment of biological effects of marine pollution is crucial for marine environment monitoring. In the Bay of Biscay, the common flatfish Solea sp., is considered to be recognized as sentinel species in pollution monitoring programmes. The present study uses juvenile Solea sp. (23.24± 1.22cm standard length) exposed to contamination conditions to better understand toxicity processes involved based on biochemical biomarkers and histopathology. Solea senegalensis was exposed to three different experimental set ups: (a) contaminated sediments; waterborne metal (Cd) and (c) waterborne organic pollutant (Benz(o)pyrene). A battery of biochemical biomarkers was analysed in samples of liver and brain: Catalase, glutathione S-transferase, acetylcysteine and superoxide dismutase. Exposure to contaminated sediments led to reduction of catalase, glutathione S-transferase and superoxide dismutase activities and induction of acetylcysteine transferase activities. Exposure to waterborne toxicants provoked a reduction of catalase and glutathione S-transferase activities. Biochemical biomarkers in sole were sensitive enough to differentiate degree of response after three days of exposure. Histopathological responses were detected after long-term exposures showing higher prevalence of liver alterations such as hyperaemia, melanomacrophage centres and necrosis. The present laboratory experiments helped characterizing the impact of pollution in sole at different levels of biological organization and different time scales. Work funded by Spanish MINECO (CTM2012-37202-C02-01/21) and through the Spanish Government through Consolidated Research Groups fellowship (IT810-18).

MO008 BIOMARKER AND GENE TRANSCRIPTION VARIABILITY IN PERCH IN REFERENCE SITES USED FOR BIOMonitoring STUDIES

L. Forlin, N. Askar, University of Gothenburg / Department of Biological and Environmental Sciences; M. Töpel, University of Gothenburg / Department of Marine Sciences; T. Osterlund, Chalmers University of Technology / Mathematical Sciences; J. Parkonen, J. Sturve, University of Gothenburg / Department of Biological and Environmental Sciences. Perch (Perca fluviatilis) has been used in biological effect monitoring point of sources in Sweden for many years, for example in studies of effects of industrial effluents. Since 1988, perch has also annually been included in a program for integrated coastal fish monitoring in three reference sites along the Swedish east coast, sites characterized by no or minor local anthropogenic influences. Long term studies of reference sites offer the possibility to follow the natural variability of physiological and biochemical endpoint (i.e. biomarkers) that defines the changes of relevance in polluted sites. The presence of a physiological and biochemical endpoints (i.e. biomarkers) clear time trends for “early warning” signs of impaired health are noted in the perch from these three reference sites possibly as a result of increased baseline pollution. The data sets also show relatively large variances between years. To further investigate these time trends and to identify if or not additional temporal variation in biological parameters, global gene transcription studies using RNA sequencing was performed. Perch collected in 2010 and 2014 were selected as they showed variation in several biomarkers such as the activity of the detoxification enzyme CYP1A (EROD), plasma levels of vitellogenin, markers for oxidative stress, white blood cells count and gonad sizes. The RNA sequencing analysis changed the framework used to identify the natural variability of the five sexually mature female perch collected in 2010 compared to the five individuals from 2014. Also principal component analysis (PCA) using all sequenced transcripts identified large differences in gene transcription as well as in regulatory mechanisms. Additional biological processes having temporal variation have been identified compared to the previous measurements of biomarkers.

MO009 Cellular and tissue-level biomarkers in mussels (Mytilus edulis) sampled in two different study areas in the Northern Atlantic

Marine Biology and Biotechnology PIEUPVEHU
Biomarker approach has been widely used in mussel monitoring programs for several years. However, up to know it has not been commonly used in high latitude study areas. In order to establish reference values of cellular- and tissue-level biomarkers in the Northern Atlantic Ocean, mussels of two sizes (small, 2-3 cm, large, 3.5-4.5 cm) from selected polluted (commercial harbor & ports, WWTP dumping area) and reference sites in Tromso (69° 40´ N), and Trondheim (63° 26´ N) were sampled in early autumn of 2016 and late summer 2017. Different tissue-level biomarkers including cell type composition (VvBAS) in digestive gland epithelium, structural changes of digestive alveoli (MLR/MET), relative proportion of digestive and connective tissue (CTD) and histopathological alterations in the digestive gland were measured. In addition, lipofuscin and neutral lipid accumulation were evaluated, and by histological analysis, paracrine and parasitosis in the endo-lysosomal system (LSC) of digestive cells were also determined. Higher VvBAS values were recorded in polluted sites than in mussels from reference sites in both study areas. Moreover, mussels from impacted sites exhibited enhanced atrophy of the digestive alveoli (high MLR/MET values) and retraction of digestive diverticula resulting in apparently higher relative extent of interstitial connective tissue (high CTD ratio). Overall, the sample mussels responded to the toxicant burdens and atresia, higher weighed prevalence values than in the reference site were recorded in the two polluted sites from Tromsø. Differences between the two mussel sizes were recorded in parasitic burden, large mussels exhibiting a higher level of parastitization than small mussels. Lipofuscin accumulation was higher and neutral lipid accumulation lower in the polluted sites than in reference sites in both study areas. Lyso and adiposomes were a rich diet element in every two size of oil spills biomarkers respond similarly in both study areas indicating the suitability of the selected biomarkers in order to be applied in the Northern Atlantic Ocean. Acknowledgements: Work funded by, EU GRACE Project (Grant Agreement Number 679266), Basque Government (IT10-13) and UPV/EHU (UIF 11/37).

MO010 Cytotoxicity of the WAF of naphthene North Sea crude oil with and without dispersant in hemocytes of the marine mussel Mytilus galloprovincialis (L.). G. Nicolussi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology, Science and Technology Faculty and Plentzia Marine Station, University of the Basque Country (UPV/EHU), Basque Country, Spain; A. Katsumiti, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; D. Bilbao, University of the Basque country (UPV/EHU) / IBeA Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE. Oil pollution coming from accidental oil spills and from activities related to oil production and transport has a detrimental effect on biodiversity. The effects of marine pollutants may vary depending on environmental parameters such as temperature. There is a need to develop efficient tools to assess the risks of oil pollution and of oil spill response strategies, such as the use of dispersants. The aim of this work was to apply an in vitro approach using hemocytes of the marine mussel Mytilus galloprovincialis as a model to evaluate the toxicity of the water accommodated fraction (WAF) of naphthenic North Sea crude oil produced at different temperatures (10, 15 and 20°C) with and without the dispersant Finasol OSR 52. In order to evaluate the contribution of the dispersant on the toxicity of the WAF plus dispersant, the cytotoxicity of the dispersant alone was also tested. Primary cultures of hemocytes were exposed in glass covered microplates to different dilutions of WAF (0.25, 2.5, 25, 50 and 100%) with and without the dispersant and to the dispersant alone at the same concentrations present in the WAF dilutions of oil plus dispersant (1.25, 12.5, 125, 250 and 500 mg/L). After 24 h exposure, cytotoxicity (MTT test) and ROS production were measured. WAF was moderately cytotoxic to mussel hemocytes. WAF produced at different temperatures showed similar cytotoxicity to hemocytes. A slight but significant decrease in cell viability occurred at 25, 50 and 100% WAF produced at 10°C. Bigger differences were observed at 20°C. These results suggest that relevance of temperature of WAF production on its cytotoxicity is limited. WAF caused a significant induction of ROS production in hemocytes, indicating occurrence of oxidative stress. When tested alone, the dispersant caused a slight but significant decrease in cell viability at the two highest concentrations. However, WAF produced with dispersant at the three different temperatures was not toxic to hemocytes. These results appear to indicate that the dispersant may efficiently reduced the toxicity of the crude oil WAF in the selected cell model. Overall, the in vitro toxicity testing approach in mussel hemocytes could be used as a rapid screening tool for environmental risk assessment of oil spills and oil response strategies in the marine environment. *Funded by EU H2020 GRACE project (679266), Spanish MINECO NACE project (CTM2016-81130-R), Basque Government (consolidated research group IT10-13) and UPV/EHU (UIF 11/37).

MO011 Determination of inorganic cations and amines in wastewater, surface water, and neutralizing amine solutions by IC coupled with a single quadrupole MS T. Christophsen, Thermo Fisher Scientific / Strategic Ion Chromatography Applications; G. Ellison, ThermoFisher Scientific / Chromatography and mass spectrometry division; T. Cross, Thermo Fisher Scientific; J. Rohrer, Thermo Fisher Scientific / Chromatography and mass spectrometry division. Inorganic cation and amine determinations are important to assess salt-build up in WAF plus dispersant (1.25, 12.5, 125, 250 and 500 mg/L). After 24 h exposure, cytotoxicity (MTT test) and ROS production were measured. WAF was moderately cytotoxic to mussel hemocytes. WAF produced at different temperatures showed similar cytotoxicity to hemocytes. A slight but significant decrease in cell viability occurred at 25, 50 and 100% WAF produced at 10°C. Bigger differences were observed at 20°C. These results suggest that relevance of temperature of WAF production on its cytotoxicity is limited. WAF caused a significant induction of ROS production in hemocytes, indicating occurrence of oxidative stress. When tested alone, the dispersant caused a slight but significant decrease in cell viability at the two highest concentrations. However, WAF produced with dispersant at the three different temperatures was not toxic to hemocytes. These results appear to indicate that the dispersant may efficiently reduced the toxicity of the crude oil WAF in the selected cell model. Overall, the in vitro toxicity testing approach in mussel hemocytes could be used as a rapid screening tool for environmental risk assessment of oil spills and oil response strategies in the marine environment. *Funded by EU H2020 GRACE project (679266), Spanish MINECO NACE project (CTM2016-81130-R), Basque Government (consolidated research group IT10-13) and UPV/EHU (UIF 11/37).

MO012 Distribution and ecological risk assessment of palm stearin in coastal marine environments of Hong Kong after an accidental pollution in Pearl River Estuary, Southest China G. Zhou, R.W. Lai, R.C. Sham, C. Lam, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K. Yeung, J.C. Astudillo, The University of Hong Kong; K.K. Ho, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; M.M. Yung, J.K. Yau, The University of Hong Kong / The University of Hong Kong / The Swire Institute of Marine Science On 3 August 2017, two container vessels collided in the Pearl River Estuary, southwest of Hong Kong, leading to release over 1000 tonnes of palm stearin into adjacent seawaters. Palm stearin is a by-product of palm oil processing and contains high levels of saturated fatty acids. On its management, it was toxic to microalgae species as reflected by growth inhibition. Its toxic mechanisms on the microalgae may be associated with its adsorption onto microagal cells, and reducton of light penetration to the cells due to obstruction from the stearin and palm oil. At present, we are generating additional toxicity data on other microagal species (Thalassiosira weissflogii and Tetraselmis suecica). Using all toxicity data generated from this study, we will ultimately determine an interim WQG for the palm stearin, and use this WQG to derive interim water quality guidelines (WQG) of the palm stearin and thereby assess its ecological risks to local marine ecosystems. This study represents the first comprehensive investigation on the ecological risk of the palm stearin in the world, and the results will facilitate informed decision-making by the environmental authority.

MO013 Ecological impacts of larvicidal oil on the marine ecosystem: implications on its management K. Yeung, The University of Hong Kong / K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science. Mosquitoes are some of the most influential insects to mankind in the world due to their ability to transmit diseases to humans, resulting in millions of deaths every year. Prevention of mosquito-borne diseases and elimination of mosquitoes is important to protect human health. Among different methods of eliminating mosquitoes, the use of larvicidal oil is the most common way being employed in Hong Kong. However, larvicidal oil will be eventually released into the marine environment...
environment due to rainfall and surface runoff, and thus it may affect marine organisms. However, its toxicity and ecological risk to marine organisms remain largely unknown. Therefore, this study aims at investigating the environmental fate of larvicidal oil in the marine environment and its toxicities towards marine organisms at different trophic levels along the food chain. The composition of larvicidal oil was characterized by gas chromatography-mass spectrometry. It was found to consist mainly of aliphatic petroleum hydrocarbons (from n-octane to n-pentadecane). The concentrations of larvicidal oil were determined with the range from 6.92 mg/L to 53.89 mg/L, by analyzing water samples collected along coastal areas in Hong Kong. Standard acute toxicity tests were conducted to investigate their toxic effects to the marine microalgae Isochrysis galbana and Chaetoceros gracilis (primary producers), the intertidal copepod Tigriopus japonicas (a primary consumer), the brine shrimp Artemia franciscana and fish embryos of the marine medaka Oryzias melastigma. Our results showed that although all test marine species were not very sensitive to larvicidal oil with the ranking of their acute median lethal concentrations (LC50) that were all above the estimated hazardous concentration for 5% of species (HC5), the results of a probabilistic risk assessment showed that the local marine ecosystem had 65.7% of change to be at risk. Still, the contamination by poly cyclic aromatic hydrocarbons (PAHs) remains one of the most ubiquitous sources of pollution in the marine environment, being reported to elicit toxic, carcinogenic and mutagenic effects on marine biota. Moreover, the assessment of these impacts in costal invertebrates after a spill, the extent of these effects and energetic trade-offs, potential recovery, and even which species to use is still deemed for an effective environmental contamination assessment. After an accidental industrial oil spill at the rocky shore of Peniche, Portugal in the summer of 2018, the water was analyzed during the low-tide for PAHs one week later and regularly throughout six months in the spilled beach and in 7 other rocky beaches in the vicinity. Also, at all locations, Patella depressa and Gibbula umbilicalis organisms were collected, and several biomarkers were used to assess the PAH exposure in water, as well as biological effects including acetylcholinesterase, oxidative stress enzyme catalase and superoxide dismutase, oxidative damage DNA damage and lipid peroxidation, energy metabolism lactate and isocitrate dehydrogenase, and electron transfer system, and carbohydrates, lipids and proteins energy reserves were assessed. The impacts of this oil spill over the two coastal invertebrate species’ biomarkers was compared over the differentially PAH contaminated sites and their sensitivity evaluated. Also, organism’s ability to recover over time was also addressed and these tools and species potential for costal monitoring pollution scenarios discussed.

**MO014 Effects of coastal oil spill on marine invertebrates and their potential to recover**

M.F. Lemos, S. Silva, Instituto Politécnico de Leiria / MARE IPLeiria

There has been an increasing public concern and focus on marine contamination issues mainly due to the arising of emergent pollutants, posing a major threat to human and environmental health. Still, the contamination by poly cyclic aromatic hydrocarbons (PAHs) remains one of the most ubiquitous sources of pollution in the marine environment, being reported to elicit toxic, carcinogenic and mutagenic effects on marine biota. Moreover, the assessment of these impacts in costal invertebrates after a spill, the extent of these effects and energetic trade-offs, potential recovery, and even which species to use is still deemed for an effective environmental contamination assessment. After an accidental industrial oil spill at the rocky shore of Peniche, Portugal in the summer of 2018, the water was analyzed during the low-tide for PAHs one week later and regularly throughout six months in the spilled beach and in 7 other rocky beaches in the vicinity. Also, at all locations, Patella depressa and Gibbula umbilicalis organisms were collected, and several biomarkers were used to assess the PAH exposure in water, as well as biological effects including acetylcholinesterase, oxidative stress enzyme catalase and superoxide dismutase, oxidative damage DNA damage and lipid peroxidation, energy metabolism lactate and isocitrate dehydrogenase, and electron transfer system, and carbohydrates, lipids and proteins energy reserves were assessed. The impacts of this oil spill over the two coastal invertebrate species’ biomarkers was compared over the differentially PAH contaminated sites and their sensitivity evaluated. Also, organism’s ability to recover over time was also addressed and these tools and species potential for costal monitoring pollution scenarios discussed.

**MO014 Effects of oil exposure on visual function in early life stage fishes**

T.J. Magnusson, University of North Texas / Biology; A.J. Klurisgara, The University of Texas at Austin / Marine Science Institute; E. Allmon, The University of Texas at Austin; A. Esbaugh, University of Texas Marine Science Institute / Department of Marine Science; R.M. Heuer, University of Miami / Marine Biology and Ecology; J.D. Stiegitz, M. Grosell, RSMAS University of Miami / Marine Biology and Ecology; A.P. Roberts, University of North Texas / Advanced Environmental Research Institute

The Deepwater Horizon oil spill released millions of barrels of oil into the Gulf of Mexico, coinciding with peak spawning periods of ecologically important fish species, such as the mahi-mahi ( Coryphaena hippurus), red drum ( Sciaenops ocellatus), and sheepshead minnow ( Cyprinodon variegatus). Downregulation of genes important in eye development and function, as well as morphological abnormalities, has resulted from polycyclic aromatic hydrocarbons (PAHs) present in the oil at concentrations less than 10 µg/L, impacting fish vision. Mahi-mahi, red drum, and sheepshead minnow embryos were exposed to weathered crude oil and assessed for visual function using the flicker-fusion principle to monitor an optomotor response, with subsequent histological analysis taken of each larva’s retina. Oil-exposed larvae exhibited a reduced PAH-dependent optomotor response with a reduction in retinal layers and neuronal connections that play an important role in visual function and image processing. The present study provides evidence that weathered crude oil affects the visual system in developing larval fish, and relates oil-induced histological effects to behavioral endpoints. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520, Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

**MO016 Effects of oil spill on coastal seaweed in the Arctic**

S. Wegeberg, Aarhus University / Department of Bioscience; J. Frit-Rasmussen, K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment

In case of an acute oil spill response operation, decision making regarding the operational response strategy and prioritizing biology at risk must be resolved. For that a Net Environmental Benefit Analysis, NEBA, is often performed to achieve the optimal environmental benefit with respect to choice of oil spill combat technology and biology at risk. To provide data for assessing the impact of oil spills in the Arctic areas, the effects of oil smothering of the macroalgae Fucus distichus, which is a dominant species in the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in sea, were studied. Effects of four different oil types were tested, including crude oil types, bunker oil and marine dispersant oil types. The two types of dispersants were exposed to the origin of crude oil and refinery process, and hence may have different effects due to their physical and chemical characterizations. Photosynthetic activity was measured as proxy for effect on growth and the self-cleaning potential was tested by wash in sea for oil smothered tips of F. distichus over a period of 2 weeks. The removal of the oils from the seaweed surface was considered as relatively fast (T½ = 3–4 days). Depending of oil type, the oil inhibited or stimulated photosynthetic activity. Marine diesel inhibited photosynthetic activity, whereas the three other oil types stimulated the activity. Thus, in general, the results indicated 1) that oil smothering was relatively fast washed off in the sea water; 2) that, depending on the oil type, photosynthetic activity were stimulated or inhibited; and 3) that the photosynthetic activity was still affected (stimulated or inhibited) even after 14 days, although oil on the seaweed surface is washed off. Therefore, photo-inhibited tips of F. distichus may be an indicator species for oil contamination in the Arctic and a potential tool for monitoring the presence of oil spills.
fractioned by column chromatography into fractions of: saturated hydrocarbons for all microlocations was made a lithological profile. Most of the samples have had vertical migration in the alluvial area of Sava river. The investigation was started in Heating plant “New Belgrade” is located on the left coast of the Sava. Chemistry; S. Miletic, J. Avdalov

MO019 NEW METHODOLOGY TO DETERMINE BTEX IN SOIL SAMPLES BY HPLC-DAD L. Silva, Universidade Federal do ABC / PROGRAD - C.D. da Silva, E.C. Lima, UFABC / CCNH; D. Rosas, UFABC / CECS Benzene, toluene, ethylbenzene and xylene, commonly referred as BTEX, are constituents of fossil fuels that cause serious negative impacts on the environment and human health. At fuel stations whose storage tanks are leaking, these substances may in contact with the soil and even reach the groundwater. In order to detect the concentration of these compounds in contaminated soils, gas chromatography (GC) is the most commonly used technique. In the present work it is proposed the use of high performance liquid chromatography coupled to diode array detection (HPLC-DAD) for the determination of BTEX in soil samples. A methodology was developed using as mobile phase methanol and H2O acidified with 250μL of H3PO4 (70:30, v/v), Elexion XDB C18 column (5μm x 4.6 x 250mm), flow of 1.5 μL min⁻¹, λ = 250 nm and T = 50 °C. The analysis was carried out using the Agilent 1220 HPLC system equipped with an automatic injector, a column oven, and a diode array detector. Data was acquired using the OpenLAB A01.05.01 software. A calibration curve for BTEX standards was constructed in 7 concentration levels: 1 to 68 ppm for benzene, 1 to 80 ppm for toluene, 1 to 80 ethylbenzene and 1 to 85 for xylene. The curves were submitted to inter- and intra-assay repeatability analyzes. Standard curves with adjustments above 0.991 relative standard deviations (% RSD) of less than 1.9% were obtained. Reproducibility tests were performed with two solutions obtained from the standard solution. In the samples containing analytes from the soil contaminated with gasoline, % RSD was obtained below 6.5% and recovery rate was 68% for benzene and 75% for toluene, 78% for ethylbenzene and 78% for xylene. The method of soil analysis via HPLC is therefore efficient and as an alternative to be highlighted for analyzes of soils contaminated with gasoline. It is intended to validate the methodology using appropriate protocols and apply it in contaminated areas for the verification of BTEX levels in next step.

MO020 Petroleum pollution of alluvial sediments near Sava river, Serbia M. Ilic, IChTM / Department of Chemistry; S. Bulatovic, Faculty of Chemistry, University of Belgrade; T. Sovevic Knudsen, IChTM / Department for Chemistry; J. Milic, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; S. Miletic, J. Avdalovic, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; G. Devic, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Heating plant “New Belgrade” is located on the left coast of the Sava River, about 1km from its estuary in the Danube, and represents a potential source of petroleum pollutants for the alluvial area of the river, ground water as well as Sava river. The aim of our research was to determine the presence of petroleum pollutants and their vertical migration in the alluvial area of Sava river. The investigation was started in the summer of 2015. The soil was sampled in three different microlocations (Z1, Z3 and Z5) up to depth of 1.5m. The sampled material was organized in the layers, and for all microlocations was made a lithological profile. Most of the samples have had a clayey-sand structure with low content of organic matter. Extraction of petroleum pollutants from soil samples were done using the Soxhlet apparatus with dichloromethane. After extraction, the dichloromethane extracts were then fractioned by column chromatography into fractions of: saturated hydrocarbons (Fraction I), aromatic hydrocarbons (Fraction II), and polycyclic aromatic hydrocarbons (PAHs) (Fraction III) [1]. For monitoring changes in the vertical migration of petroleum pollutants, and the relationship of this migration with the soil characteristics, the group composition was determined for each borehole of all microlocations, taking into account their lithological profiles. Results of our research showed that in all samples the most represented were polar compounds (Fraction III), while the saturated hydrocarbons were least represented (Fraction I). This trend is almost unchanged in samples from different microlocation at different depths. It can be concluded that composition of petroleum pollutants can be unchanged through the alluvial sediments up to 15m depth and they can reach the underground waters consequently, and thus the groundwater contamination, without the need of the environment. References: Miletic S., Ilic M., Avdalovic J., Sovevic Knudsen T., Belkoski V.P., Braminij JVovancicbev B., Vrivic M.M. (2015) Oil pollution in the vicinity of a heating plant in New Belgrade (Serbia) – influence on the quality of the surrounding soil and sediments. 16th European Meeting on Environmental Chemistry, EMC16, Book of Abstracts. November 30 – December 03. 2015.

Torrino, Italy. Acknowledgements This work was supported in part by Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No: III 43004.

MO021 Prey capture to male aggression: the role of ecologically relevant behaviours in the assessment of complex petroleum based contaminants. D. Philibert, University of Alberta / Biological Sciences; D. Lyons, C. Philibert, University of Alberta; K.B. Tierney, University of Alberta / Biological Sciences

Risk-Based Approach: Assessment of Offshore Discharge Waters K. Wadhia, National Oilwell Varco (NOV) / Environmental; O. Pelz, BP / Gulf Coast Restoration Organization; S. Cousins, BP

In 2012, OSPAR (Oslo and Paris Conventions) adopted the recommendation 2012/5 for a ‘Risk-Based Approach (RBA)’ to the management of Produced Water (PW) discharges from offshore installations’. The application of the RBA recommendations (2012/5) is implemented by the UK’s regulator, the Department for Business, Energy and Industrial Strategy (BEIS). The objective of the RBA is to assess the environmental risk of a PW discharge in the OSPAR maritime area. This is achieved by analysing the effluent and added substances to obtain a measure of the toxicity of the discharge using in vitro methods and the four Ecological Risk Index (ERI) criteria. A Produced Water Management Plan (PWMP) must be adopted to comply with the RBA regulatory requirements. Processing the information generated by the RBA, each PWMP would be specific to the discharged effluent, platform and area, aiming to minimise environmental risk of each PW discharge. The RBA method is compiled of a six-step process. The steps are based on a standard method where a Predicted Environmental Concentration (PEC) and a Predicted No Effect Concentration (PNEC) of the PW or individual products are determined, and a PEC/PNEC ratio is calculated. The PEC/PNEC ratio and Environmental Impact Factor (EIF) which describes a PEC/PNEC ratio in a specified volume of water characterises the potential risk posed to the receiving environment. With use of a decision matrix the fate of the PW and thus the relative environmental risk can be mapped specifically to the installation area providing an overall risk profile. The PW is additionally characterised at a substance level, highlighting components which contribute to the overall environmental risk, and will feed directly into the PWMP. Notably in the UK RBA methodology is the absence of PW WEA concerning sensitivity to fish, and we therefore studied the comparative contribution from production chemicals & naturally occurring substances, and validity of the stepwise tiered screening approach, the investigation of provided valuable assessment into adequacy and sensitivity of ecologically relevant species and the implications for regulatory monitoring regime.
MO023
Risk-based assessment of produced water discharges - need for alignment

M.G. Smits, Shell International

Produced formation water is the main waste stream from upstream oil and gas activities. For offshore installations, next to produced water reinjection (PWR), discharge of treated produced water is a commonly used disposal route applied in line with ALARP principles (As Low As Practicably Reasonable). In order to properly manage produced water discharges, a variety of principles have been adopted in national and international regulatory frameworks focusing on e.g. the oil in water content, toxicity of produced water, PBT characteristics of applied offshore chemicals, environmental monitoring, etc. The onus is on the industry to comply with regulations in the country of operation, to properly manage the risk of produced water discharges and to relieve any concerns over the potential environmental effects in the receiving marine environment. For this purpose the industry is applying a diversity of tools and methods within the framework of risk-based assessment (RBA). Tools and methods range from simple (tier 1) screening tools to comprehensive (tier 3) field verification programs and include among others: chemical analysis, determination of PBT characteristics through whole effluent toxicity studies and modeling, dilution screening and 3D dispersion modelling, etc. Within those practices a wide range of risk endpoints are being applied, each with their own level of conservatism. Without harmonization of endpoints it is difficult to interpret when risks can considered to be adequately controlled. For example, different approaches base the assessment on either chronic or acute toxicity data. And where one method considers an acceptable mixing zone of 500m, the other might apply 100m (USEPA). This hampers straightforward comparison of results of risk-based assessments across industry and regulatory frameworks. Different objectives of the assessment undertaken might, however, be a reason for existing differences in methods. It is, therefore, crucial that for each assessment method a corresponding assessment objective is formulated and communicated. This presentation will provide an overview of RBA practices currently being applied by the industry to offshore produced water disposal, showing main assumptions, input requirements, risk endpoints applied and corresponding assessment objectives. Examples will be used to highlight the need for further harmonization of approaches. Development of industry guidance including a common tiered framework for RBA is suggested as a first step to achieve this.

MO024
Spatial and temporal analysis of the risks posed by total petroleum hydrocarbon and trace element contaminants in coastal waters of Kuwait

E.E. Nicolaou, Cefas Lowestoft Laboratory / Environment and Ecosystems

Nine trace elements including As, Cd, Cu, Fe, Hg, Ni, Pb, V and Zn, and total petroleum hydrocarbon (TPH) concentrations were measured in Kuwaiti coastal waters since 1984 from Kuwaiti coastal waters. Here it was investigated whether concentrations of these determinants are at levels above Kuwaiti and internationally established assessment criteria (AC). The results indicate that Cu and Cd had the most Kuwaiti AC breaches over time. Comparing the data of the last sampled year to the least stringent international AC, then Cu and Cd showed breaches at all stations. The trend in trace metal contamination signals significant environmental impacts especially for Cd and Hg. No determinant measured showed a significant upward trend, indicating that water pollution for these contaminants is not a worsening situation. However, further sampling should be carried out to confirm these findings, especially at shoreline locations, where routine monitoring ceased in 2011 to investigate any recent changes.

MO025
Temperature-dependent toxicity of Naphthenic North Sea crude oil WAF, dispersant and their mixture: sea urchin bioassays

L.d. Miguel, University of the Basque country (UPV/EHU) / Department of Zoology and Animal Cell Biology, U. Izagirre, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology, Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIEEE; I. Marigomez, Eusko Harriko Unibertsitatea / Zoology & Animal Cell Biology (Sci & Tech Fac)

Maritime traffic and oil platforms in the North and Baltic Sea have been growing during the last years and the risk of oil spills is consequently increasing. Oil spills may cause significant and long-lasting adverse effects on marine ecosystems. The aim of this work was to assess the potential toxicity of WAF produced from; Naphthenic North Sea crude oil (NNS), Finasol OSR52 dispersant (Total Fluids) and their mixture (NNS+Finasol OSR52) in a wide range of temperatures (5, 10, 15, 20 and 25°C). In order to identify temperature-dependent toxicity, acute toxicity bioassays using larvae and embryos of the sea urchin Paracentrotus lividus (Lamark) were performed. After the exposure period, EC₅₀ values were calculated and length of larvae was measured to assess the inhibition of larvae growth. Additionally, larvae abnormalities were determined to calculate a general index of toxicity (IT). In the present study, at 25°C NNS WAF provoked a lower inhibition of larval length than the other studied temperatures. Accordingly, oil toxicity seems to be influenced by temperature. Indeed, temperature is known to affect hydrocarbon solubility and evaporation, and dispersant effectiveness. The same trend was found for Finasol OSR52 WAF. However, high temperature seems not to follow the same pattern in the case of the mixture. EC₅₀ and IT values were in accordance showing that dispersion increases WAF toxicity. Overall, results showed that temperature affects oil, dispersant and chemical dispersant toxicity. In this study, larval abnormalities and reduced larval growth indicate that toxicity was lower in crude oil WAF than in dispersant WAF, with their mixture in between, for all the temperatures tested. Acknowledgement – This work has been funded by the EU H2020-BG-2005-2 project GRACE (grant agreement number 679266), Spanish Ministry of Education, Culture and Sport (PhD fellowship L.D.M FPUS/05/1317 grant) and the Basque Government (Consolidated Research Group GIC IT8110-13).

MO026
Temporal variability of acute toxicity of Produced Formation Water discharged from offshore platforms: the responses of sea bass (Dicentrarchus labrax L., 1758) larvae

L. Mariani, CNR-IRS / RSA; E. Magaletti, B. Di Lorenzo, F. Onorati, C. Virno Lamberti, ISPRA Institute for Environmental Protection and Research

The Higher Institute for Environmental Protection and Research (ISPRA) is responsible for the evaluation of the potential environmental impact on marine ecosystem caused by the Produced Formation Water (PFW) discharged from Italian gas offshore platforms. A multidisciplinary approach has been applied through the monitoring of chemical-physical characteristics of water and sediment, matched with biological investigations, such as eco-toxicological bioassays on bacterial, algae, rotifers, crustaceans, echnidnoids and fishes. The PFW is an efficient containing complex mixtures of contaminants, the composition of which may change with time. It is therefore necessary to analyse a large number of samples taken over a long period of time in order to adequately assess the toxicity of this effluent. The present paper describes a specific toxic test within the whole study: the variability of the acute toxicity responses of fish to PFW collected on two offshore gas platforms in three years (2003-2005). More sensitive life stages (post larvae of 25-45 days old) of European sea bass (Dicentrarchus labrax L., 1758) were used. Tests were performed over 24 h and 96 h and the dilutions 6.25, 12.5, 25.0, 50.0, 100.0 % PFW were used. The LC₅₀ on post larvae ranged from 17.67 ± 37.42 % PFW. The LC₅₀ on post larvae ranged from 6.68 ± 15.61 % PFW. The PFW acute toxicity responses showed a temporal variability of PFW as it is highlighted by standard deviation values of LC₅₀ data: exposure 24h (25.61 ± 7.02% PFW); 96h (10.84 ± 3.37 % PFW).In accordance with GESAMP recommendations (2007), the work stresses the importance of accurate estimates and measures of oil inputs into the sea, by increasing the number and frequency of samples needed to estimate the environmental hazard of PFW.

MO027
Tentative identification of halogenated polycyclic aromatic hydrocarbons in biota

Z. Xia, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; W. Johnson, University of Manitoba / Chemistry; O. Francisco, I. Idowu, University of Manitoba; J. Stetefeld, University of Manitoba / Chemistry; G. Tenny, Department of Fisheries & Oceans / Department of Chemistry Poly cyclic aromatic compounds (PACs) are a complex class of compounds that are present in fossil material such as petroleum oils. The most common PACs are the poly cyclic aromatic hydrocarbons (PAHs) of which 16 have been identified as priority compounds by the United States Environmental Protection Agency. However, there are other important PACs that to date have received less attention. These include halogenated PAHs, non-halogenated alkylated PAHs and heterocyclic aromatic compounds that contain S-, O- and N-atoms. Halogenated PACs especially those containing chlorine atoms are likely to be more environmentally persistent than their non-halogenated analogues because of the presence of the halogen atoms. In addition, the toxicity of some halogenated PAHs have been found to be similar to dibeno-p-dioxins and dibenzofurans. Because C1 and Br ions are present in the marine environment, we hypothesize that halogenated PACs can be formed and will be bioaccumulate in biota samples. Here we present a method based on high resolution gas chromatography coupled to mass spectrometry using specific multiple reaction monitoring (MRM) ion transitions in the electron ionization mode to detect and quantify halogenated PACs in biological samples. The method was used on a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment. Preliminary results show that 1-chlorophenore is present in this sample. In addition, we observed multiple peak reports on a MRM chromatogram coupled to mass spectrometry of chloro-anthracene/phenanthrene but we do not have authentic analytical standards to match retention times. Work is ongoing to identify other halogenated compounds present in biological samples from Canada.

MO028
The experience with the use of biomarkers as Risk Indicators in Environmental Risk Assessment of oil based discharges offshore

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Department
An approach to integrate biomarkers into probabilistic risk assessment has recently been developed and published regarding oil based discharges offshore. The main purpose has been to enable the use of monitored biomarker responses offshore as Risk Indicators in the procedures for Environmental Risk Assessment of produced water (PW) discharges. The principles of the approach and experiences obtained in applying it to existing oil field monitoring data will be presented. The approach was tested by applying it to a number of data from the latest surveys in the biomarker based Column Monitoring (WCM) program on the Norwegian Continental Shelf for assessment of PW effects. Cases including both a typical PW discharge and an alternative discharge make the data set interesting for testing the interpretation capability of the approach. At the site with no discharge of PW at the time of the sampling, the contamination could be traced to the sources of contamination. The experiences gained are discussed in relation to contaminant sources, use of the approach to provide assessment criteria for biomarkers, and for the performance of the biomarkers as risk indicators in relation to assessed environmental risk.

MO029
Tissue-level biomarkers and histopathological alterations in mussels (Mytilus trossulus) from the Baltic Sea exposed to water accommodated fractions of crude oil
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The brackish Baltic Sea is a fragile ecosystem potentially sensitive to oil spills. Chemical disappers are an effective method to mitigate coastal impacts of oil spills; however, oil treated with dispersants may have unknown toxic effects on benthos. The Baltic Sea blue mussel (Mytilus trossulus) is a particular variety of marine mussels adapted to low salinity. Early winter mussels were collected scuba diving in Tvärminne (Finland) in November 2016, taken to laboratory facilities and acclimatized at the experimental temperature of 5ºC to two different salinity regimes, the local 5.6 and the artificially increased 15.0 representing the southern Baltic Sea. Mussels were exposed to water accommodated fractions (WAF) and chemically dispersed WAF (dispersant Finasol O51) mixtures (WAF-D) and sampled at 0, 1, 7 and 21 d. Tissue level biomarkers were investigated to determine the following biological responses: cell type composition (volume density of basophilic cells, Vbas) of the digestive gland epithelium, structural changes of digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/MET), mean epithelial thickness/mean diverticular radius (CTD), gonadal development and other histopathological alterations in digestive gland, gonad and gills. Vbas increased significantly after 1 d in mussels exposed to WAF and WAF-D at the salinity of 15.0, and decreased afterwards. MLR/MET changed markedly with exposure time at 15.0 whereas MET/MDR showed no response. High CTD values in mussels observed at the salinity of 5.6 indicate a poorer condition of the digestive gland at low salinities that can be a protective response (atrophy, decreased activity, haemocytic infiltration, granulocytomas) were being assessed, being more evident in mussels exposed to WAF and WAF-D (21 d). Salinity is a major factor controlling the biology of mussels in the Baltic Sea. The results obtained here indicate that during the early winter the health of native mussels in the very low salinity central-northern part of the sea is more easily impaired than in those inhabiting the more saline southern regions. The current study is among the first ones applying tissue level biomarkers in Mytilus trossulus in the Baltic Sea and provides preliminary reference values for future biomonitoring programmes in the area. Acknowledgements: Funded GRACE project (EU H2020 grant N°769266) and a Basque Gov. fellowship to EGU.

MO030
Toxicity of diluted bitumen to freshwater fish and invertebrates
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Toxicity of bitumen may involve aversive effects and chronic toxicity of two blends of dilute bitumens ("dilbit") and weathered dilbit on freshwater fish and invertebrates after exposure to vidiferent concentrations of physically-dispersed (water accommodated fraction; WAF) and chemically-dispersed (chemically-enhanced WAF; CEWAf). Toxicity of weathered, unweathered and dispersed Access Western Blend (AWB) dilbit was evaluated on fathead minnow (Pimephales promelas). Toxicity of weathered and unweathered Cold Lake Blend (CLB) dilbit was assessed on Rainbow trout (Oncorhyncus mykiss), and two invertebrate species, daphnia (Daphnia magna) and ceriodaphnia (Ceriodaphnia dubia). For fathead minnow, unweathered AWB demonstrated a significantly higher toxicity (LC50-96 h = 0.628 g/L) compared to the weathered AWB (LC50-96 h = 2.06 g/L). Chronic toxicity tests showed that fathead minnow lethality was also higher for AWB (LC50-7 d = 0.593 g/L) compared to the weathered AWB (LC50-7 d = 1.31 g/L) whereas larval growth toxicity was lower for AWB (IC25-7 d = 0.312 g/L) compared to the weathered dilbit (IC25-7 d = 0.096 g/L). Rainbow trout exposed to unweathered CLB demonstrated a significantly higher toxicity (LC50-96 h = 5.66 g/L) compared to the weathered CLB (LC50-96 h = 0.57 mg/L). LC50 (48 h) was also observed on ceriodaphnia exposed to the CLB WAF where no mortality was observed with the weathered CLB. The reproductive effects on ceriodaphnia were greater with the CLB (IC50 < 1.0) than with the weathered CLB (IC25 = 1.99 g/L). Volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) increased as the dilbit WAF increased.

MO031
Toxicity of produced water from offshore oil production in Norway and corresponding pol and apolar fractions
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Regulation of produced water (PW) discharges on the Norwegian continental shelf is based on maximum 0% toxicity may be toxicological, with coverage of conventional oil quantification methods based on traditional GC is limited when it comes to polar compounds that originate from produced crude oils. Furthermore, the use of treatment or production chemicals might also contribute to the overall PW toxicity. As a result, there may be discrepancies between measured concentrations of organic compounds and the total polar compounds that contribute to the toxic responses. Currently, there is little or no regulation of the polar PW fractions. The total extractable fractions from four oil platforms on the Norwegian continental shelf. PWs were selected from oil fields of different operational ages, which produce oils exhibiting different physical and chemical properties. Samples were subjected to extraction with dichloromethane, followed by fractionation into apolar and polar fractions using solid phase extraction, recovering 80 % of the total GC amenable material in these fractions. The total extracts and fractions were thoroughly characterized using GC–MS, GCxGC–MS, LC–Orbitrap-MS, and by direct infusion FT–ICR–MS. The total PW extract, as well as the apolar and polar fractions were subject to acute toxicity tests using nauplii of the marine copepod Acartia tonsa. LC50 values for the total PW extracts were found between 0.05–0.98 mg L−1 (based on total GC amenable fractions analysis). For the polar fractions, the toxicity was mainly attributed to the apolar fraction of the fourth PW, with an LC50 of 0.05 mg L−1. For the PWs where toxicity mostly related to the polyaromatic fraction, this fraction spanned from 16–55% of the total PW (GC amenable fraction analysis). The PW where toxicity mostly related to the apolar fraction this was 35%. This study demonstrates that at the current stage of development of the PW fraction analysis. For the PW where toxicity mostly related to the apolar fraction this was 35%. This study demonstrates that at the current stage of development of the PW fraction analysis. The approach was pursued with a wider array of PWs from a range of sources to determine if alternative methods of characterization are needed for regulation of PW discharges.

MO032
Toxicokinetics of oil components in Arctic copepods
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To comprehend the implications of large oil spills in the Arctic marine environment, we need a better understanding of the toxicokinetics of oil in true Arctic conditions. The central hydrocarbon chain, as well as its life history strategies and Arctic adaptation, makes it a relevant Arctic species. The central position of Calanus hyperboreus (based on total GC amenable fractions analysis). For the polyaromatic fraction, this fraction spanned from 16–55% of the total PW (GC amenable fraction analysis). The PW where toxicity mostly related to the apolar fraction this was 35%. This study demonstrates that at the current stage of development of the PW fraction analysis. The approach was pursued with a wider array of PWs from a range of sources to determine if alternative methods of characterization are needed for regulation of PW discharges.
CLls, the slope was close to unity, indicating a similarity between structural lipids and octanol. The lower slope for CV signifies that storage lipids are less well represented by octanol. Elimination rates were consistently higher in the CLls than the CVs, resulting in a substantially longer half-time of elimination and high retention of oil components in the CVs. We discuss the role that various biological factors may contribute to this difference.

MO305
Seabird-derived contaminant biomarkers and genotoxicity in Collemboila from the Arctic
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Seabirds occupy high trophic positions and due to biomagnification their bodies contain high concentrations of many anthropogenic contaminants. In the Arctic they have been shown to function as important biovectors of contaminants from ocean to land. The tundra near bird cliffs is heavily influenced by nutritious and contaminant-enriched guano and is generally characterised by rich and diverse vegetation. In these areas, springtails (Collemboila) contribute to a high proportion of the soil organic carbon and biomass. They play a vital role in decomposition processes such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collemboila. Two Collemboila species and their habitat (soil/moss) were sampled at 7 sites with high, medium and low seabird influence in West Spitsbergen, Svalbard, and analysed for a wide range of organic contaminants, mercury (Hg), and stable isotope ratios of carbon and nitrogen (δ13C and δ15N, respectively). In addition, Collemboila were analysed for genotoxic responses, i.e. the amount of DNA strand breaks and micronucleus frequency. Seabird influence (indicated by δ15N) and contaminant concentrations were indicated to be higher in soil/moss sampled closer to the bird cliffs (0–150 m) compared to further away (250–400 m) within the same site. When comparing among sites overall, no association between δ15N and contaminant load was found. The total contaminant loads in habitat samples were dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collemboila were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs) or polybrominated diphenyl ethers (PBDEs), and chlorodanes (CHLs). No association was observed between contaminant concentrations in Collemboila and habitat. DNA fragmentation was higher in Collemboila from sites with high seabird influence, compared to sites with medium and low. No differences in microneucleus frequency (MN) was found between sites or species. This is the first study on MN in Collemboila and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both PCBs and contaminant load levels, increasing with concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).

MO306
Higher contaminants and poorer condition in an Antarctic avian top predator from 2001 to 2013
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A large number of chemicals associated with chemical exposure to the Antarctic ecosystem has been considered low. However, recent investigations have shown that south polar skuas (Catharacta maccormicki) has the highest levels of biomagnifying contaminants among Antarctic seabirds. The present study quantifies OHC levels in south polar skua (Catharacta maccormicki) to compare with previous data from the same colony, collected during the season of 2001/2002. South polar skuas were sampled during the breeding season of 2013/2014 in Svarthamaren, Dronning Maud Land, Antarctica. Whole blood was analysed for 87 OHCs of which 36 were detected. Stable isotope ratio of carbon (δ13C) and nitrogen (δ15N) in blood, were used to determine carbon source and relative trophic position, respectively. In 2013/2014, predominant contaminants were Mirex (8484 ng/g lw) and Hexachlorobenzene (HCB) (3561 ng/g lw). These levels were higher than those reported from other south polar colonies and Antarctic seabirds at similar ecological niches. Multivariate analysis indicated that skuas sampled late in the breeding season had higher concentration of perfluoralkyl substances (PFASs) and lower relative contribution of lipophilic contaminants. The relative contribution of lower polybrominated diphenyl ethers (PBDEs). Due to low intraspecific variance in δ13C and δ15N, no significant associations were found between OHCs and isotopes. However, lack of associations could also be due to influence of migration, wintering habitat and different turnover rates in OHCs and isotopes. Skuas from 2013/2014 had significantly higher concentrations of most OHCs and a lower body condition than skuas from 2001/2002. PCBs, Mirex and HCB increased with 105%, 40% and 60%, respectively, between 2001/2002 and 2013/2014. Ratios of Mirex/ΣPCB and Mirex/HCB decreased between the two seasons, suggesting stabilizing Mirex levels and possibly declining levels in the future. Further studies should elucidate the effects of wintering grounds and diet, as well as the level and contaminant occurrence in Antarctic Petrel (Thalassoica antarctica), the main prey

Wildlife ecotoxicology: laboratory dosing studies to field

population assessments (P)

MO303
Two Dimensional Gas Chromatography for the analysis of polycyclic aromatic compounds and their alkylated homologues in environmental samples
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Polycyclic aromatic compounds (PACs) and their alkylated homologues are ubiquitous and known environmental contaminants. Due to their structural diversity and complexity of alkyl-substituted PACs, the resolution of individual alkyl congeners, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). The peak capacity of the two dimensional-GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and quantification of PACs and their alkylated homologues was performed from muscle samples and separate whole fish samples, and the results indicated the presence of oxidized forms of CWA compounds in most of the muscle samples. Established biomarkers were loaded with CWAs were intentionally sunk and are still laying on the deep bottoms of the Baltic Sea. The current programme of the EU Baltic Sea Region Interreg project DAIMON investigates temporal change of organochlorine contaminant (OCs) by comparing habitat and different turnover rates in OHCs and isotopes. Skuas from wintering areas are sampled closer to the bird cliffs (0–150 m) compared to further away (250–400 m) within the same site. When comparing among sites overall, no association between δ15N and contaminant load was found. The total contaminant load was found dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collemboila were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs) or polybrominated diphenyl ethers (PBDEs), and chlorodanes (CHLs). No association was observed between contaminant concentrations in Collemboila and habitat. DNA fragmentation was higher in Collemboila from sites with high seabird influence, compared to sites with medium and low. No differences in microneucleus frequency (MN) was found between sites or species. This is the first study on MN in Collemboila and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both PCBs and contaminant load levels, increasing with concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).
of south polar skua during the breeding season. Keywords: Antarctic, south polar skua, stable isotopes, temporal variation, OHC

MO037 Evaluation of malformations induced by a hospital effluent of Toluca (Estado de México) in Lithobates catesbeianus H. Jelín-Flores, Instituto de la zona Metropolitana del Estado de México / Toxicology; A. S. Pérez-Alvarez, Universidad Autónoma del Estado de México / Environmental Toxicology; L. Gómez-Oliván, Autonomous University of the State of Mexico / Chemistry; M. Galar-Martínez, Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas; N. Sanjuán-Reyes, Autonomous University of the State of México / Chemistry; O. Dublan-García, Universidad Autónoma del Estado de México / Facultad de Química; M. Hernandez-Navarro, Universidad Autónoma del Estado de México / Toxicology

Hospital effluents are important from the ecotoxicological point of view and are an important source of pollutants emission, among which are pharmaceutical products, chemical residues, radioelements, disinfectants and heavy metals, among others, which are waste of daily activities and has reported that they can reach concentrations between 4 and 150 times higher than those detected in municipal effluents. In addition to this, they usually do not have adequate pre-treatment before their emission, so they can be mixed with other effluents from homes , industries and municipal wastewater, which can subsequently generate interactions, enhance effects and create synergies, which lead to induce adverse effects on the environment, so it is important to study. The Estado de México is located in the center of the country and is considered the entity with the largest population and according to data reported in 2015, it has 1835 medical units of different levels of care. On the other hand, Lithobates catesbeianus is a species considered native of the state and has been proposed by the government as an alternative to food supplement (due to its protein content). Due to the aforementioned, the objective of this work was to evaluate the malformations generated by a hospital effluent of Toluca (Estado de México) in this species and compare with Xenopus laevis, a species that is used as a preferred bioindicator, using the frog embryo teratogenesis assay: Xenopus (FETAX). For this purpose oocytes in mid-blastula transition were exposed for 96 h to six different concentrations of the effluent (0.1, 0.3, 0.5, 0.7, 0.9 and 1%), subsequently, the mean lethal concentration (LC50) effective concentration inducing 50% malformation (EC50), and the teratogenic index (TI) was obtained. Results indicates that lower concentrations of the hospital effluent induced slightly higher malformations and lethal effects in X. laevis (EC50=0.132%, LC50=0.508%, IT=3.8) and in L. catesbeianus (EC50=0.351%, LC50=1.431%, TI=4.0), the major alterations being microcephaly, cardiac and facial edema, malformations in the eye, notochord, tail, fin and intestine. However, the lightest alterations with concentration of 1% induce the highest percentage of fish exposed to this hospital effluent will be malformed in the absence of mortality compared to X. laevis, and therefore, can be considered as a sensitive and useful species to evaluate toxic effects of contaminant with the FETAX assay.

MO038 Monitoring fish health in a densely populated catchment in Central Germany M. Schweizer, University of Tubingen / Animal Physiological Ecology; A. Dieterich, S. Betz, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; N. Corral Morillas, Eberhard Karls Universität Tübingen; C. Dewald, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; D. Leim, Eberhard Karls Universität Tübingen; L. Miksch, S. Nelson, V. Prozmann, J. Röthoff, Eberhard Karls Universität Tübingen / Animal Physiological Ecology; R. Triebkov, University of Tubingen / Animal Physiological Ecology; H. Körler, University of Tubingen / Animal Physiological Ecology

In the frame of the joint project NIddaMan coordinated by the Goethe University Frankfurt/Main we investigated health parameters of fish from the River Nidda and its tributaries Horloff and Usa in Central Germany. The Nidda river system is regarded as a typical river system for central Europe as it passes a very densely populated area and as it is heavily influenced by anthropogenic factors including agriculture, communal waste water and industrial discharges. To get a broad populated area and as it is heavily influenced by anthropogenic factors including its tributaries Horloff and Usa in Central Germany. The Nidda river system is in Frankfurt/Main we investigated health parameters of fish from the River Nidda and agriculture, communal waste water and industrial discharges. To get a broad populated area and as it is heavily influenced by anthropogenic factors including its tributaries Horloff and Usa in Central Germany. 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relationships (Pearson, R=0.11) between the ChE and the weight or sex of the birds. The weight of the birds decreased on average 1.54 g after the exposure, possibly due to the stress of capture and the lack of adaptation to captivity. The house sparrow showed to be a species sensitive to the presence of OP compounds in the environment. It is possible that the house sparrow and other birds that co-inhabit the agricultural areas where malathion is applied, as well as other OP insecticides, are prone to develop different levels of intoxication and that in some cases their health condition is compromised.

MO042 Implementation of a worst-case landscape scenario for population modelling of a fungicide applied in cereals
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The mobilization of metal(loids) in the earth’s crust due to anthropogenic activities, such as mining, is one of the main contamination routes for wildlife. Both the objective of biomonitoring and validating non-invasive methods for metal analysis in reptiles, levels of lead (Pb) and mercury (Hg) in blood, faeces and carapace scales of freshwater turtles (Mauremys leprosa, n=86) from historical mining areas (i.e. Valle de Alcudia-Sierra Madrona district for Pb, Almadén district for Hg) in Central Spain were analysed. The highest levels of blood Pb were found in the animals collected from the area of Valle de Alcudia-Sierra Madrona, more specifically from Solana del Pino, with an average (±SD) of 5.59±3.66 μg/g dry weight (dw). Individuals from this location showed the clearest evidences of oxidative stress, as estimated from the highest values of malondialdehyde (b biomarker of lipid peroxidation) and superoxide dismutase activity. However, no correlations were found between these biomarkers and blood Pb levels. Similarly, the highest levels of Hg were detected in the animals collected from the area of Almadén, specifically from Almadenejos, with an average (±SD) of 8.83±8.84 μg/g dw. These individuals showed higher oxidative stress as well as unspecific neurotoxic effects. Repeatedly executed Bti exposures reduced after repeated Bti exposures, while body condition was similar throughout the laboratory approach, tadpoles experienced exposure conditions similar to realistic nuisance associated with mosquitoes coming from temporary flooded wetlands. Amphibians co-occurring with mosquito larvae in these wetlands may be exposed to Bti products several times during their breeding season. Up to now, information regarding effects on the non-targeted group of amphibians has to be regarded rather inconsistent. On this account, we evaluated how repeated exposures to frequently used Bti formulations (VectoBac®2AS, VectoBac®WG) in field-relevant rates affect European common frog (Rana temporaria) larvae. In a laboratory approach, tadpoles experienced exposure conditions similar to realistic mosquito control in the Upper Rhine Valley (Germany). We assessed potential effects with regard to enzymatic biomarkers (glutathione-S-transferase, glutathione reductase, acetylcholine esterase), development, body condition and survival until the end of metamorphosis. Regardless of the formulation, delivery form or application rate, tadpole survival rates and time to metamorphosis were slightly reduced after repeated Bti exposures, while body condition was similar throughout the treatments. Furthermore, Bti induced significant increases of all enzymatic activities irrespectively of the applied field rate and formulation, indicating oxidative stress as well as unspecific neurotoxic effects. Repeatedly executed Bti applications, especially acting on early developmental stages, seem to increase the risk for adverse effects. The examination of several biochemical markers is needed to evaluate the ecotoxicological risk of Bti for amphibian populations, especially in the context of worldwide amphibian declines. Following the precautionary principle, the implementation of certain thresholds for application numbers and intervals should be considered in order to ensure environmentally friendly mosquito control programs, especially in areas originally designated for nature conservation.

MO045 European common frog (Rana temporaria) larvae show subcellular responses upon field-relevant Bacillus thuringiensis var. israelensis (Bti) exposure levels used in mosquito control
S. Allegier, B. Frombold, University Koblenz-Landau, V. Mingo, Trier University / Biogeography; C. Bruhel, University of Koblenz-Landau / Institute for Environmental Sciences
Bacillus thuringiensis var. israelensis (Bti) is presumed to be an environmental friendly agent for use in either health-related mosquito control or the reduction of nuisance associated with mosquitoes coming from temporary flooded wetlands. Amphibians co-occurring with mosquito larvae in these wetlands may be exposed to Bti products several times during their breeding season. Up to now, information regarding effects on the non-targeted group of amphibians has to be regarded rather inconsistent. On this account, we evaluated how repeated exposures to frequently used Bti formulations (VectoBac®2AS, VectoBac®WG) in field-relevant rates affect European common frog (Rana temporaria) larvae. In a laboratory approach, tadpoles experienced exposure conditions similar to realistic mosquito control in the Upper Rhine Valley (Germany). We assessed potential effects with regard to enzymatic biomarkers (glutathione-S-transferase, glutathione reductase, acetylcholine esterase), development, body condition and survival until the end of metamorphosis. Regardless of the formulation, delivery form or application rate, tadpole survival rates and time to metamorphosis were slightly reduced after repeated Bti exposures, while body condition was similar throughout the treatments. Furthermore, Bti induced significant increases of all enzymatic activities irrespectively of the applied field rate and formulation, indicating oxidative stress as well as unspecific neurotoxic effects. Repeatedly executed Bti applications, especially acting on early developmental stages, seem to increase the risk for adverse effects. The examination of several biochemical markers is needed to evaluate the ecotoxicological risk of Bti for amphibian populations, especially in the context of worldwide amphibian declines. Following the precautionary principle, the implementation of certain thresholds for application numbers and intervals should be considered in order to ensure environmentally friendly mosquito control programs, especially in areas originally designated for nature conservation.

MO046 Influence of salinity and temperature on tadpoles of Xenopus laevis
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Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to increased seawater intrusion. Climate change projections indicate that the mean temperatures will rise in the near future. To address these concerns, the European Food Safety Authority (EFSA) has published a Science Opinion addressing the state of the science regarding the risk to amphibians and reptiles exposed to pesticides (EFSA 2017). A central task of the EFSA working group was to understand how well important life stages, exposure routes and endpoints are currently covered (or not) by the current risk assessment paradigm. We had four steps in this analysis: 1) Identify relevant life-stages, important exposure routes and possible endpoints with relevance to the specific protection goals (SPGs) defined for amphibians; 2) Evaluate the coverage by existing standard test guidelines with regard to these important stages/routes/effects; 3) Explore whether tests with surrogate species could provide sufficient information allowing extrapolation to assess the hazards for amphibians; 4) Identify proposed non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. For amphibians, greater coverage or surrogacy exists for the aquatic larval stage and short term effects, with less coverage of the adult terrestrial stage, reproductive toxicity, and the potential for the potential for the dermal exposure routes. To cover important life stages, exposure routes and effects, tests addressing dermal overspray and reproductive toxicity in amphibians may be needed. The analysis for reptiles will be presented in a separate poster. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians were supported after the analysis of the currently available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of amphibians within the remit of the PPP authorization.
with increasing salinity. Although significant interactions between temperature and salt concentration were registered, a pattern of influence in the temperature was not observed. Adverse effects were observed at the lowest tested salinity levels, which suggest that these species are highly vulnerable to small salinity increases and would be at high risk under seawater intrusion scenarios. Keywords: Salinity; toxicity; amphibia

MO047 EFFECTS OF THE EXPOSURE OF LARVAS OF Dendropsophus colombianus (ANURA: HYLIDAE) TO WATERS CONTAMINATED BY ANTHROPOGENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES

P. Rojas, Universidad de Caldas; B. Toro, Universidad de Caldas / Biological Sciences

The pollution generated by agriculture, livestock and mining has impacted the watersheds in the Colombian Andes. Amphibians have been used to evaluate this contamination due to their biophysical lifecycle, which has made them ideal models in aquatic ecotoxicology. The objectives of this work were: 1) to determine if tadpoles of *D. colombianus* exposed to contaminants of agricultural, livestock and mining origin (with mercury: Hg, and with mercury and cyanide: Hg:CN) varied in the snout-vent length (SVL), tail length (TL), head width (HW), and body weight, and 2) to evaluate the effect of exposure on metamorphosis and behavior of the larvae. The AMPHITOX protocol was followed using ten larvae in each of the treatments and in the control, which were exposed from the moment of hatching to complete metamorphosis. Significant differences were found in the LRC between the larvae of the control and the Hg:CN mixing treatment (Z= -28.92, p= 0.000) and between Hg:CN mining and agriculture treatments (Z= 25.325, p= 0.001) after 50 days of exposure. Differences in LC were found between the larvae of the control and the Hg/CCN mixing treatment (Z= -25.57, p= 0.001), and between Hg:CCN mining and Hg:CCN mixing treatments (Z= 21.52, p= 0.009) in the same time. The weight did not show differences. The majority of larvae of the control and the agriculture treatment showed similar development rates, reaching stage 46 between days 60 and 75 of exposure. While tadpoles exposed to Hg:CCN mining did not complete the metamorphosis and reached stage 42 between days 50 and 55. Surface flotation was the activity that was most stable at the time of exposure, presenting percentages of individuals greater than 60% in the control (81%), and in the agriculture (70%) and Hg mining treatments (65%), between the last days of exposure evaluated: 22 to 28. It is shown that 1) the effects on growth of anuran larvae due to agricultural, livestock and mining contamination are similar. However, samples contaminated by mining produce smaller tadpoles than agriculture and livestock, and 2) tadpoles exposed to agricultural and livestock contamination, unlike other studies which report that exposure to metamorphosis, show a time of this process that approximates to the time of the species experimented in the control (134 days) and probably, to the time of this in situ.

MO048 Risks for amphibians and reptiles by dermal exposure to pesticides

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Amphibian and reptilian species are found in agricultural landscapes. Some inhabit water bodies either permanently or during some time of their life cycle. Others use predator as temporary refuges. Some species migrate long distances through fields and some reside in fields and field margins where they can be exposed to pesticide residues in food items, water, soil and plant surfaces. A number of studies indicate that pesticide exposure can lead to severe impacts with up to 100% mortality from overspray at field rates for some pesticides. Dermal exposure was identified as an important exposure route in the EFSA opinion. The aim of the current study was to investigate different options to address the risk from dermal exposure by overspray and contact to soil and plant surfaces. Existing exposure models were reviewed with regard to their suitability for amphibian and reptilian risk assessment. This included comparison of parameters used in model calculations, comparison of sensitivity to dermal exposure and worst case exposure calculations to different groups of amphibians and reptiles. Greatest dermal exposure from overspray and to compare it with exposure from contact to soil and plant surfaces. In addition a novel approach was developed to estimate the uptake from soil and plant surfaces. Mammalian dermal toxicity related to local effects and dermal adsorption data may be used as surrogates for reptiles but not for amphibians. The development of a test method investigating local effects on amphibians is ongoing. The aim of the current study is to evaluate the risk of amphibian and reptilian species exposed to pesticides (EFSA 2017). A central task of the EFSA working group was to understand how well important life stages, exposure routes and endpoints are currently covered (or not) by the current risk assessment methodology. We had four steps in this analysis: 1) Identify relevant life-stages, important exposure routes and possible endpoints with relevance to the specific protection goals (SPGs) defined for these groups; 2) Evaluate the coverage by existing standard test guidelines with regard to these important stages/routes/effects; 3) Explore whether tests with surrogate species could provide suitable information allowing for extrapolation to assess the hazard/risk for amphibians and reptiles; 4) Identify proposed
non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians and reptiles. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. Reptiles have very little data with which to assess the coverage of important life stages and exposure routes. Current knowledge suggests that surrogacy based on bird or mammal data may not be appropriate for the juvenile and adult stages of reptiles, though data are very limited. Reptile eggs are not covered by any aspect of the current risk assessment paradigm, but it is unknown to what extent reptile eggs lay eggs in crop fields, and how likely exposures are to occur to eggs under realistic scenarios. Therefore, more data are needed to determine if this is a vulnerable life stage that needs specific consideration. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to reptiles were supported after the addition of the current available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of reptiles within the remit of the pesticide authorization.

**MO052 AmphioMove: Moving patterns and microhabitat selection of European anurans in agricultural landscapes**


The current decline of amphibian populations on global and local scales is discussed as a consequence of the changing environment. Studies suggest that enhanced application of plant protection products (PPP) is one of the main reasons that today amphibians represent the most endangered vertebrate group in Europe. The first version of a scientific opinion currently released by EFSA (European Food Safety Authority) highlights the need for including amphibians in the risk assessment of plant protection products. Specifics in terms of physiology (e.g., permeable skin) and ecology (e.g., aquatic and terrestrial life-stages in amphibians) as well as life stages and patterns (habitat preferences) make this taxon in particular vulnerable to pesticide applications in agricultural landscapes. It is emphasized that detailed ecological data of especially terrestrial amphibians is still under-represented but required for a comprehensive risk evaluation of all amphibian life-stages. The aim of this project AmphioMove is to fill the gap on terrestrial life stages of European anurans with focus on moving patterns and microhabitat selection in agricultural landscapes. At two study sites individuals of common toads (Bufo bufo) and common frogs (Rana temporaria) were caught at around their breeding ponds, fit with a transmitter and afterwards tracked via radio-telemetry. Locations, biotic and abiotic parameters of the selected microhabitats were recorded daily. We show preliminary results of the first period of data collection for common toads from March to October 2017.

**MO053 A quantitative AOP for activation of the aryl hydrocarbon receptor leading to early life stage mortality in amphibians and reptiles**

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The cu activities through which Dioxin-like Compounds (DLCs) or their non-ortho substituted metabolites (e.g. 3,3',4,4'-pentachlorobiphenyl (PCB 126), or 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)) affect all classes of organisms (including the QAs currently under discussion) is well documented (e.g. refs. 1 and 2). However, it is currently unknown how variations in exposure conditions (e.g. temperature) could affect the outcome of this process. The aim of this study was to assess the metal concentration accumulated by two species of Tomé sea turtles (Eretmochelys imbricata and Chelonia mydas) and infer about possible impacts of such contamination on their general stress responses and health status. More specifically, the final goal was to find correlations between metals in their tissues and the expression of key genes involved in detoxification and metal transport, antioxidant responses and oxidative stress, immunological responses, mitochondrial respiratory and energy production, among others, which could be indicative of these organisms health and future viability. To achieve these goals, nesting female turtles were sampled for blood and skin tissues, immediately after egg laying in their well-documented spawning sites in S. Tomé. Skin samples were collected from the right flipper of the turtles and stored at -20°C until analysis of metal concentrations. Blood samples were withdrawn from the external jugular vein and stored in RNAlater at -20°C until RNA extraction and gene expression analysis using quantitative real-time PCR (qPCR). Additionally, body mass and carapace length were also recorded, along with all information regarding

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**DO historically metal-exposed amphibian populations acquire resistance to lethal levels?**

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The aims of this work were to 1) determine oxidative stress and metal burden in anuran tadpoles from historically metal exposed populations (Hg/Pb), and 2) assess if tadpoles from impacted sites have increased tolerance to metals relative to tadpoles from reference sites. Metal body burden, oxidative stress biomarkers and metallothioneins (MT) were measured in Pelophylax perezi tadpoles from reference and metal contaminated sites. Additional tadpoles (20 per site) were collected and exposed in lab conditions during 24 h to Hg or Pb levels above the median lethal concentrations reported for amphibians (1.5 and 10.5 mg/L, respectively). The parameters mentioned above plus mortality were monitored at the end of the assay. Field-collected tadpoles from Pb and Hg polluted sites had higher metal body burden than those from reference sites (median per site as d.w. 540.4-708.1 vs 2.6-9.5 mg Pb/g, 768.2-3103.5 vs 0.01 ng Hg/g; all p < 0.01). Levels of MT (median, µg/g tissue) were significantly higher in tadpoles from Hg polluted sites than in the rest of locations (248.5-307.7 vs. 63.9-138.6 p < 0.01), suggesting that M. perezi can be induced in natural populations, by the sum of environmental factors. Exposure to Hg caused mortality of all individuals, while Pb did not result lethal to tadpoles. Laboratory exposure revealed that experimental treatment rather than pollution at the origin site determined Pb body burden (controls: from reference site 96.7-120.4 ng Pb/g, from Pb site 118-491.6 ng Pb/g; exposed: from reference site 36979.9-54760.4 ng Pb/g from Pb site: 9043.5-76852.4 ng Pb/g), showing that Pb was readily bioavailable for exposed tadpoles. Lab exposure to Pb increased MT levels in tadpoles from reference sites (exposed vs. non-exposed: 116.3 vs. 41.70 µg/g p < 0.01), but not in those from Pb-polluted areas. Oxidative stress biomarkers did not differ either between origin sites or because of experimental exposure to Pb. MT levels in tadpoles from reference populations that were taken to the laboratory and kept alive under controlled conditions did not decrease in the laboratory (105.99-138.66 vs 29.29-41.70 µg/g p < 0.05). This could be a consequence of a reduction in the laboratory of stress sources other than metals that can also induce MT synthesis (e.g. thermal stress). The fact that this decrease was not observed in tadpoles from Pb-polluted sites (105.61-109.41 vs 193.50-130.23 µg/g p < 0.05) would suggest that these animals may have high constitutive MT levels.

**MO055 Assessment of metal contamination levels and stress responses of endangered sea turtles of São Tomé and Príncipe**

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São Tomé Island harbors important sea turtle nesting and feeding sites. However, insufficient enforcement of environmental laws to avoid illegal take of nesting females and eggs, associated with a great lack of knowledge about how these species interact with their environment and how human activities impact their survival in the region, constitute significant challenges for sea turtle conservation. Through current local conservation projects, some information on genetics and nutrition of sea turtle populations is being unveiled but very little is known about how sea turtles are using polluted areas. Oxidative stress (OS) biomarkers are a useful tool to assess the metal contamination accumulated by two species of Tomé sea turtles (Eretmochelys imbricata and Chelonia mydas) and infer about possible impacts of such contamination on their general stress responses and health status. More specifically, the final goal was to find correlations between metals in their tissues and the expression of key genes involved in detoxification and sequestration and metal transport, antioxidant responses and oxidative stress, immunological responses, mitochondrial respiratory and energy production, among others, which could be indicative of these organisms health and future viability. To achieve these goals, nesting female turtles were sampled for blood and skin tissues, immediately after egg laying in their well-documented spawning sites in S. Tomé. Skin samples were collected from the right front flipper of the turtles and stored at -20°C until RNA extraction and gene expression analysis using quantitative real-time PCR (qPCR). Additionally, body mass and carapace length were also recorded, along with all information regarding...
MO056 Ecotoxicology of Africa's three largest reptiles: POPs, metals, eggs, and eggshells
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The Nile Crocodile (Crocodylus niloticus), Loggerhead Turtle (Caretta caretta) and Leatherback Sea Turtle (Dermochelys coriacea) are the largest reptiles in Africa. The bioaccumulation and effects of metals and metalloids on large-bodied reptiles are less well known compared with birds and mammals, especially those from Sub-Saharan Africa. Globally, reptiles are experiencing declines, and pollution is one of the hypothesized reasons for the decline. The Nile Crocodile and Loggerhead Turtle are at relatively high trophic levels, with the Nile Crocodile also being the largest predator in Africa. We sampled eggs from these three species (27 crocodile, and 10 each from the two turtle species) and analysed the shells and contents separately for metallic elements using ICP-MS. Trophic level, body size, and migratory patterns influenced the concentrations in shells and egg contents, but crocodiles generally seem to have lower concentrations than the sea turtles. Compared with data from elsewhere, sea turtle eggs had lower concentrations, but crocodile eggs had higher copper and mercury concentrations. Comparisons between eggshells and egg content elemental compositions for each species clearly showed that eggshells cannot be used as proxy for egg contents. Sampling therefore, requires the collection and analyses of unhatched eggs. Relative elemental composition patterns indicated overlaps for the respective egg components of the sea turtles, but not for the crocodiles. We found thicker eggshells significantly associated with higher iron concentrations in the crocodiles. The implications may be that hatchlings may spend more energy to break through the leathery shells, and may therefore affect reproduction. Copper had concentrations that raised concern in all three species. The strontium concentration in the eggshells of the Leatherback Turtle was high. Mercury, copper, and lead were higher in crocodile eggs than in turtle eggs. Additionally, Intergovernmental Panel on Climate Change (IPCC) reported alarming projections for sea levels rise in the AR5 at 2013. Within this scenario, it is foreseen the salinisation of low-lying coastal freshwater ecosystems due to the intrusion of seawater, which will adversely affect many populations of amphibians. *Peleopodyx perezi* is distributed along all coastal territory in Portugal, where there are some populations highly correlated to environmental levels of seawater. Though this species has been reported as tolerant to high salinity levels, there is a lack of knowledge regarding long term effects of salinization to natural populations of this amphibian species. The present work aimed at characterizing the lethal and sublethal sensitivity to salinization of early life stages of *P. perezi* originated from reference and salinized natural populations. Embryos (Gosner stage 8-10) were exposed for 96h, and tadpoles (Gosner stage 25-30) for 72h to 168h (test dependent) to several dilutions of seawater and concentrations of NaCl (used as a surrogate of seawater to increase salinity). The following endpoints were monitored: time until hatching, growth and feeding. Comparing the results for time to hatch between salinization-impacted and non-impacted populations, differences were not found. For this endpoint, NaCl revealed to be more toxic than seawater (EC50 of 14.04 and EC50=11.89 mM/cm for sea water and NaCl, respectively). As well, for the other monitored endpoint (tadpole growth, weight and feeding) NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater dilutions.

MO059 Wildfires effects on aquatic invertebrates organisms with in situ bioassays
N. Abrantes, University of Aveiro / CESAM/DAO; A. Ré, University of Aveiro / Department of Biology and CESAM; I. Campos, University of Aveiro / Department of Environment and CESAM; J. Pereira, University of Aveiro / Department of Environment and Marine Studies; J.J. Keizer, University of Aveiro / Department of Environment and Planning CESAM; F. Gonçalves, University of Aveiro / Department of Biology and CESAM

In the last decades, the increased frequency and extent of wildfires have become a societal and environmental problem in Portugal. Among the distinct environmental impacts, the role of wildfire on the water quality has increasingly received research attention, particularly in the input of persistent organic pollutants to freshwater ecosystems due to the pollution of burned ash and sediments. The Central region of Portugal is facing an increasing risk of wildfires due to climatic changes, society and human activities. Coastal wetlands are a priority for conservation because they are biodiversity hotspots and have high ecological importance in ecosystem services. However, they are amenably exposed to strong anthropogenic pollution and climatic extremes. Additionally, Clionais; S. Costa, Universidade de Aveiro / Department of Biology & CESAM, 3810-193 Aveiro, I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

Coastal wetlands are a priority for conservation because they are biodiversity hotspots and have high ecological importance in ecosystem services. However, they are amenably exposed to strong anthropogenic pressure and climatic extremes. Additionally, Intergovernmental Panel on Climate Change (IPCC) reported alarming projections for sea levels rise in the AR5 at 2013. Within this scenario, it is foreseen the salinisation of low-lying coastal freshwater ecosystems due to the intrusion of seawater, which will adversely affect many populations of amphibians. *Peleopodyx perezi* is distributed along all coastal territory in Portugal, where there are some populations highly correlated to environmental levels of seawater. Though this species has been reported as tolerant to high salinity levels, there is a lack of knowledge regarding long term effects of salinization to natural populations of this amphibian species. The present work aimed at characterizing the lethal and sublethal sensitivity to salinization of early life stages of *P. perezi* originated from reference and salinized natural populations. Embryos (Gosner state 8-10) were exposed for 96h, and tadpoles (Gosner stage 25-30) for 72h to 168h (test dependent) to several dilutions of seawater and concentrations of NaCl (used as a surrogate of seawater to increase salinity). The following endpoints were monitored: time until hatching, growth and feeding. Comparing the results for time to hatch between salinization-impacted and non-impacted populations, differences were not found. For this endpoint, NaCl revealed to be more toxic than seawater (EC50 of 14.04 and EC50=11.89 mM/cm for sea water and NaCl, respectively). As well, for the other monitored endpoint (tadpole growth, weight and feeding) NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater dilutions.

MO100 Increasing salinisation effects on *Peleopodyx perezi* populations - Could historical exposure drive historical species distributions?
S. Costa, Universidade de Aveiro / Department of Biology & CESAM, 3810-193 Aveiro, I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

Coastal wetlands are a priority for conservation because they are biodiversity hotspots and have high ecological importance in ecosystem services. However, they are amenably exposed to strong anthropogenic pressure and climatic extremes. Additionally, Intergovernmental Panel on Climate Change (IPCC) reported alarming projections for sea levels rise in the AR5 at 2013. Within this scenario, it is foreseen the salinisation of low-lying coastal freshwater ecosystems due to the intrusion of seawater, which will adversely affect many populations of amphibians. *Peleopodyx perezi* is distributed along all coastal territory in Portugal, where there are some populations highly correlated to environmental levels of seawater. Though this species has been reported as tolerant to high salinity levels, there is a lack of knowledge regarding long term effects of salinization to natural populations of this amphibian species. The present work aimed at characterizing the lethal and sublethal sensitivity to salinization of early life stages of *P. perezi* originated from reference and salinized natural populations. Embryos (Gosner state 8-10) were exposed for 96h, and tadpoles (Gosner stage 25-30) for 72h to 168h (test dependent) to several dilutions of seawater and concentrations of NaCl (used as a surrogate of seawater to increase salinity). The following endpoints were monitored: time until hatching, growth and feeding. Comparing the results for time to hatch between salinization-impacted and non-impacted populations, differences were not found. For this endpoint, NaCl revealed to be more toxic than seawater (EC50 of 14.04 and EC50=11.89 mM/cm for sea water and NaCl, respectively). As well, for the other monitored endpoint (tadpole growth, weight and feeding) NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater dilutions.
Abstracts

New synthetic chemical compounds, like Organophosphorous Flame Retardants (OPFRs), are widely used by the industry as plastic additives in common life objects, or overlaying woods, fabrics, etc. They pose environmental risk due to their effects as androgenic or estrogenic endocrine disrupters, imitating male or female hormones respectively, interfering in vital functions of the organisms. Increasing presence of those chemicals in the water due to the incomplete elimination in the wastewater treatment plants, is emerging as a new problem in water contamination. OPFRs, like Tris (2-Chloro-1-Methyl vinyl) Phosphate (TCP), are a typical flame retardant in plastics, being the most detected chemical in the aquatic system. Possible toxic effect of this chemical has not been deeply evaluated yet. This study aims to explore the possible effect of TCP as an endocrine disruptor on the edible sea urchin Paracentrotus lividus. 392 individuals highlighted the normal DNA damage. Behavioral Responses also examined concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoroxetine at the sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.

MO063

Assessment of POPs in stranded sperm whales (Physeter macrocephalus) from the Mediterranean Sea

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The sperm whale (Physeter macrocephalus) is a large toothed whale inhabiting the Mediterranean Sea. This endangered species is subject to a number of threats such as exposure to high levels of contaminants. Several studies show high levels of persistent organic pollutants (POPs) in dolphin tissues from the Mediterranean Sea, but data on sperm whales from the same area are much more scarce. In this study, we quantified POP levels in blubber samples of sperm whales (Physeter macrocephalus) stranded on the Italian coast from 2009 to 2016. Fresh samples were spiked with a suit of PCDD/Fs, PCBs, and PBDEs. 13C-labeled standards prior to Soxhlet extraction, and then cleaned up by using the automated sample preparation system. Samples were analyzed for seventeen PCDD/Fs, twelve DL-PCBs and twenty-seven PBDEs. Quantification was carried out by the isotope dilution technique by GC-HRMS on a Trace GC Ultra coupled with a HRMS chromatograph coupled to a high-resolution mass spectrometer. Samples’ lipid content was determined gravimetrically. The relative abundance of the study contaminants followed the order DL-PCBs>PCBDEs>PCDD/Fs. The mean concentration values obtained were 6420 ng g⁻¹ (2100-20800 ng g⁻¹) for DL-PCBs, 612 ng g⁻¹ (312-1390 ng g⁻¹) for PCBs and 57.8 pg g⁻¹ (45.8-83.5 pg g⁻¹) for PBDEs. Our results indicate that those reported for the same species in the same area by a recent study from other authors save for PCB/Fs which were found in an order of magnitude lower. Yet, they were generally much higher that those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PCBDE levels, our results were lower that those reported for sperm whales from North Atlantic. The PCDF congener profile (hexa>penta>octa) was relatively similar to those reported for sperm whales from Australia and to those reported in blubber of striped dolphin (Stenella coeruleoalba) from the Mediterranean Sea. In contrast, the PCDD congener profile (hexa>penta>hepta>octa) was quite different from those with a lower contribution of higher chlorinated congeners and a higher contribution of lower chlorinated congeners. Total calculated TEQs ranged from 275 to 987 pg g⁻¹ l.w. and surpassed the threshold of 210 pg WHO Criterion (AIC), was chosen using backward selection. GLMs results indicate that adverse effect a sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.
the transcript levels of all studied genes were higher in winter when compared to summer, potentially due to enhanced metabolism over colder months. mRNA transcript levels of AHR, GR, IL1 and MT2 genes correlated positively with increasing levels of blubber SPs, supporting the occurrence of biological response to this class of contaminants. GLMs for MT2 indicated that the transcript levels of this gene are higher in dolphins from LES, possibly due to greater metal inputs in this area. GR activity was higher in dolphins with higher levels of metals. Overall, activity of the skin of bottlenose dolphins is altered due to exposure to SPs and PBDEs, which co-varied with SPs and, Mirex. Absence of influence of other contaminant classes over biomarker response might be due to low contaminant levels in sampled dolphins. This influence might also have been overshadowed by the effects sampling season. Nonetheless, results indicate a significantly high exposure to PCBs, PBDEs, Aroclor, and Mirex to trigger a biological response in dolphins from these small resident coastal populations, particularly susceptible to the negative effects associated to contaminants.

MO065 Monitoring Eleonora’s falcon conservation status both at its breeding and non-breeding grounds, using biological (stress indices) and environmental data
V. Tsarpali, University of Patras / Department of Biology; C. Barboutis, Hellenic Ornithological Society / Antikythera Bird Observatory; C. Kassara, University of Patras / Department of Biology; M. Papadimitriaki, S. Giolakas, University of Patras / Biology; S. Daliani, University of Patras / Oceanology / NOAA; T. Driouhos, Biology. The present study investigated a battery of stress indices in blood and liver of Eleonora’s falcon (Falco eleonorae Géne, 1839), a colonial breeding raptor of the Mediterranean that overwinters in SE Africa, mainly in Madagascar. In particular, cholinesterase (ChE), acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activity, as well as cellular abnormalities (MN assay) were measured in blood samples collected from wild individuals, captured on the island of Antikythera (Greece), in May (N=13) and September 2017 (N=19). The results derived from the samples that were collected in May are indicative of the habitat quality at the species’ wintering and/or staging areas, while the ones derived from the samples collected in September are indicative of the habitat quality at the species’ breeding grounds. Moreover, in order to investigate the water quality in the breeding area of F. eleonorae, natural water pond samples were collected in September 2017 and further analyzed for the presence of heavy metals. Additionally, heavy metals were measured in liver of an individual found dead near the water ponds. According to the results, total plasma ChE activity ranged between 3.70±0.433 - 11.34±0.829 nmol ml⁻¹ min⁻¹ in May and 1.44±0.079 - 9.31±0.018 nmol ml⁻¹ min⁻¹ in September. AChE activity remained almost constant between the two sampling periods, while BChE in May was significantly higher than September. Total nuclear abnormalities showed almost similar frequencies in both periods, while cytoplasmic abnormalities observed in September were significantly higher than in May. Cr and Cu levels in water samples were found to be within natural levels, however, the influence of neonicotinoids on migratory ability is poorly understood. Effects on refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory ability is poorly understood. We used white-crowned sparrows (Zonotrichia leucophrys) during spring migration to assess the direct effects of imidacloprid on the migratory behavior of seed-eating passerines. In a previous captive study, we found birds exposed to OC pesticides, PCBS, and PBDEs of its待遇治疗的干扰在行为的改变，而控制组的鸟保持了正常的行为。

MO066 Optimising design and analysis of acute effect field studies
R. Dittrich, Tier3 Solutions GmbH / Wildlife Ecology; I.S. Hotopp, Tier3 Solutions; M.M. Benito, C. Wolf, Tier3 Solutions GmbH
Vertebrate risk assessments of a plant protection product (PPP) may indicate an acute risk to wild birds and mammals and predict effects on population development. This might be driven by (too) conservative assumptions on the exposure side of the equation for the risk evaluation, due to the lack of better data. It is therefore worthy to study deeply the presence of effects in the field in order to obtain a proper risk assessment. We highlight three complementary ways to improve the quality of such field studies. We study the design conventions to the ‘extensive approach’, by using a great area or number of agricultural fields in different study sites, with the ‘intensive’ approach, by using radio-tracking techniques in a control/treatment design. This double approach covers the natural variation in parameter estimates and enables the identification of possible treatment effects. The radio-tracking technique is sensible enough to monitor the fate of individuals in a treated area over a long period of time, and to find effects on mortality. However, in most cases the critical point is the disappearance of individuals; an increase in their number can indicate a greater vulnerability to other stressors. In the context of a good study design, we also propose an improved statistical evaluation to increase the detectability of effects in comparison to earlier studies. The Kaplan-Meier survival curve and the Cox proportional hazards model are recommended as methods for the analysis of survival information. The Cox model is a well-known statistical technique used in medical tests. It provides an estimate of the treatment effect on survival adjusted for other explanatory variables. Moreover, as it isolates the effects of treatment from the effects of other covariates, the assessment of results of such field studies is facilitated. Additionally, an essential part of every statistical evaluation is to know the minimum number of individuals needed in order to perceive actual treatment effects in the statistical output. Using data from generic radio telemetry studies on real untreated populations of wood mouse and several bird species, we run simulations of acute effects for different scenarios. The results show that minimum sample size is highly dependent on, first, the species, and second, the action mode and persistence of residues of each specific PPP.

MO067 Assessing impacts of legacy pollutants on wildlife of the Trinity River (Texas, USA) using Neotropical Cormorants as indicator species
M.A. Monroe, Texas A&M University / Wildlife and Fisheries Sciences; C. Sandoval, Texas A&M University / Wildlife and Fisheries Sciences; B. Stutchbury, York University / Centre for Environmental Farming Systems.

The Trinity River (Texas, USA) has been historically known as a polluted river because of its proximity to the Dallas–Fort Worth area and also because of known discharges of sewage and agricultural irrigation waters to the river. Surprisingly, there are no studies regarding the presence of legacy contaminants in the river and their impacts to wildlife. The objectives of this study were to determine accumulation and potential impacts of persistent organic pollutants such as organochlorine pesticides, PCBs, and PBDEs on nesting aquatic birds of the Trinity River, using Neotropical cormorants (Phalacrocorax brasilianus) as indicator species. Adult and first year cormorants were collected from two sites on the Trinity River Watershed during 2014 and 2015. Tissue sections from liver, spleen, kidneys, and gonads, were used for histopathology analysis, and a portion of the liver was analyzed for OC pesticides, PCBs, and PBDEs. The tissues were collected in May (N=13) and September (N=19). The results derived from the analyses of the tissue samples that were collected in May are indicative of the habitat quality at the species’ breeding grounds, whereas the ones derived from the samples collected in September are indicative of the habitat quality at the species’ wintering and/or staging areas, which are most the most widely used class of insecticides in the world. Migratory seed-eating birds that use agricultural landscapes for refueling may be particularly susceptible to the negative effects of these contaminants. Effects on refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory ability is poorly understood. We used white-crowned sparrows (Zonotrichia leucophrys) during spring migration to assess the direct effects of imidacloprid on the migratory behavior of seed-eating passerines. In a previous captive study, we found birds exposed to OC pesticides, PCBS, and PBDEs of its benefit experienced significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northward orientation. To corroborate results from captive trials on free living birds, we conducted a study on radio-tagged white-crowned sparrows following a single oral dose of imidacloprid. Birds were caught in Ontario, Canada during spring migratory stopover and exposed via gavage to a single dose of imidacloprid of either 1.2 mg/kg bw or 3.9 mg/kg bw (n = 12 birds/treatment). Birds were held for approximately 6 hours, and their body mass and food intake were monitored. Individuals were then tagged with uniquely coded transmitters and released into into a MOTUS array of automated telemetry towers in Southern Ontario, Canada to track their movements on a landscape scale. We found that high dose birds significantly reduced food consumption, and imidacloprid exposed groups lost a significant amount of body mass relative to controls within 6 hours of dosing. Using automated telemetry data, we found that birds with the longest stopover durations were in the imidacloprid treated groups. Further analysis of the telemetry data is being used to determine effects on speed of travel and direction of migratory movements across a large water barrier.

MO068 Tracking the effects of a neonicotinoid insecticide on songbird migration
M.L. Eng, University of Saskatchewan / Toxicology; B. Stutchbury, York University; C.A. Morrissey, University of Saskatchewan / Biology
Recent decades have seen a dramatic increase in the application of neonicotinoid insecticides, which are now the most widely used class of insecticides in the world. Migratory seed-eating birds that use agricultural landscapes for refueling may be particularly susceptible to the negative effects of these contaminants. Effects on refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory ability is poorly understood. We used white-crowned sparrows (Zonotrichia leucophrys) during spring migration to assess the direct effects of imidacloprid on the migratory behavior of seed-eating passerines. In a previous captive study, we found birds exposed to OC pesticides, PCBS, and PBDEs of its benefit experienced significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northward orientation. To corroborate results from captive trials on free living birds, we conducted a study on radio-tagged white-crowned sparrows following a single oral dose of imidacloprid. Birds were caught in Ontario, Canada during spring migratory stopover and exposed via gavage to a single dose of imidacloprid of either 1.2 mg/kg bw or 3.9 mg/kg bw (n = 12 birds/treatment). Birds were held for approximately 6 hours, and their body mass and food intake were monitored. Individuals were then tagged with uniquely coded transmitters and released into into a MOTUS array of automated telemetry towers in Southern Ontario, Canada to track their movements on a landscape scale. We found that high dose birds significantly reduced food consumption, and imidacloprid exposed groups lost a significant amount of body mass relative to controls within 6 hours of dosing. Using automated telemetry data, we found that birds with the longest stopover durations were in the imidacloprid treated groups. Further analysis of the telemetry data is being used to determine effects on speed of travel and direction of migratory movements across a large water barrier.

MO069 A synthesis of the interactions between anticoagulant rodenticides and wildlife
R. Shore, Centre for Ecology & Hydrology (NERC); N. van den Brink, Wageningen University / Dep of Toxicology; J.E. Elliott, Environment Canada / SciDevNet.

Anticoagulant rodenticides (ARs) are the mainstay of rodent control throughout the world. Regulatory risk assessments indicate ARs pose a significant risk to non-target wildlife but AR use remains widely authorised because the benefits (particularly to human health) are deemed to outweigh the environmental risks. Recently, an authoritative reference text, prepared by 24 international scientists, reviewed the main issues related to ARs and wildlife, specifically: AR use, regulation, exposure pathways, toxicity, mechanism of action, pathology, pharmacokinetics, genetic resistance, non-target risk and its mitigation, alternatives
to ARs and integrated pest management (IPM). Broad concepts that emerged were: there is high conservation of the blood clotting process and so ARs can affect a wide range of non-target species; development of genetic resistance in target species led to global use of the more acutely toxic and persistent second-generation ARs (SGARs); vitamin K1 can be an effective antidote (unlike for many rodenticides); variation in non-target sensitivity may be due to pharmacokinetic, ecological and behavioural processes; >50% of predatory species contain AR residues; AR residues in nontarget exposed species of AR-induced mortality requires additional evidence (e.g., clinical signs, haemorrhagic lesions); probability of death in relation to AR residues may help assess extent of mortality in populations; tissue residues are informative of exposure but dietary AR concentrations are more suited to assess risk; and primary AR exposure associated with IA were significantly higher than those associated to risk to wild populations; knowledge of exposure and effects in vertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

MO070

Anticoagulant rodenticides in red kites (Milvus milvus) in Britain


Second generation anticoagulant rodenticides (SGARs) can be toxic to all mammals and birds. Studies have shown that, in Britain, there is widespread exposure to SGARs in a diverse range of predatory mammals and birds, including red kites (Milvus milvus). This species may be particularly at risk as it scavenges dead rats, a target species for rodent control. Investigation of SGAR exposure in red kites may be biased by an independent case may cause localized prevalence of exposure and effects in vertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

MO071

Environmental determinants of the exposure to anticoagulant rodenticides in non-target species

J. J. López-Pereza, Instituto de Investigacion en Recursos Cinegeticos / Unidad de Ecologia y Cieencia Animal; I. S. Sanchez-Barbado, UCLM-CSIC / Grupo de Toxicologia de Fauna Silvestre; P. R. Camarero, Instituto de Investigacion en Recursos Cinegeticos, CSIC-UCLM-JCCM / Grupo de Toxicologia de Fauna Silvestre; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicologia de Fauna Silvestre

Anticoagulant rodenticides have some similarities with other bioaccumulative persistent organic compounds, because of their frequent presence in many predatory species. In addition, the fact of being highly toxic substances makes this biaccumulation particularly harmful for these predators. Considering that the use of rodenticides occurs mainly in areas with high density of rodents that are in turn prey to multiple predators, we can also expect an ecological trap scenario. We studied the levels of second generation anticoagulant rodenticides (SGARs) and the environmental factors that influence such exposure in non-target species. The analysis included liver samples of wild animals (n=244) found dead between 2007 and 2016 in the region of Murcia (South of Spain). The sampling included 111 red kites (26 juvenile and 85 adults), 156 dead rats, 104 dead goldfinches (Carduelis carduelis), and 32 birds. Liver samples were analysed by LC-MS and the presence of SGARs was statistically analysed with generalized linear models with a binary logistic response to study the effect of environmental or habitat characteristics including human population and livestock density and types and surface of crops. SGARs residues were detected in 83 (34%) of the analysed animals. The SGARs corresponding to 25 (51%) species. Ten species (53 individuals) had residues of at least two SGARs (bromadiolone and difenacoum); brodifacoum and difenacoum were detected in one red kite (17%) and one dead rat (50%), respectively. The spatial analysis at the municipality level has allowed to identify the percentage of Municipalities urban area and the ecological risk of SGARs exposure in red kites. The study has given a good agreement with urban, agricultural and isolated ecosystems; knowledge of SGAR exposure in red kites can be used to evaluate the impact of SGARs on non-target species.
MO073 The potential of feathers as a biomonitoring tool for fluoxetine in wild birds S.E. Whittlock, Environment Department, University of York / Environment; K. Arnold, University of York / Environment; J. Lane, Animal and Plant Health Agency; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; R. Shore, Centre for Ecology & Hydrology (NERC).

Fluoxetine has been identified as a contaminant which may pose a risk to wild birds. However there is little empirical evidence regarding which bird species are most at risk of exposure to fluoxetine, in terms of concentration levels in wild bird samples. A significant barrier to sampling wild birds is that fluoxetine is cleared very quickly from systemic circulation and plasma concentrations might be expected to fall to levels below the limit of detection in less than one hour post-exposure. Facial sampling presents a similar problem. However, fluoxetine is detectable in the hair of humans and other mammals. We hypothesised that fluoxetine might likewise be detectable in feathers. Moult occurs over a period ranging from weeks to months and during this time, growing feathers have a blood supply. If a wild bird was exposed to fluoxetine during this period, the compound could be laid down in the feathers and subsequently be detectable. We conducted an avian study with wild-caught Eurasian starling (Sturnus vulgaris) to determine whether fluoxetine administered during a period of feather regrowth is deposited in the feathers in detectable concentrations. We removed two rectrices (tail feathers) from each bird. We then administered a dose of fluoxetine at an environmentally relevant concentration (3.8 μg d-1) each weekday throughout the regrowth period. We plucked the new feathers once they were fully regrown and analysed them by LC/MS. Populations of major and minor, bely, eyestripe, reproductive performance. Our preliminary results indicate that fluoxetine is detectable in the feathers and we will present information on the concentrations present and whether they are correlated with levels in other tissues such as liver and brain. We discuss the extent to which feathers have potential as tools for monitoring the occurrence and severity of exposure to fluoxetine in wild birds.

MO074 Field-effect studies as a suitable method to assess effects of plant protection products on free-living common voles (Microtus arvalis): A case study with the fungicide iprodione O. FueLLing, C. Miersch, Tier3 Solutions; S. Steiger, BASF SE, Agrarzentrum Limburgstein.

After foliar spray application of a plant protection product on crops, food sources of small mammals may be potentially contaminated with this product. Ingestion of treated food could possibly lead to effects on the population level (e.g. reproductive impairment etc.). In the presented study, it was examined if there were any long-term side effects from repeated foliar spray applications of the fungicide iprodione on populations of the common vole, Microtus arvalis. The field-effect study was conducted in Germany during the main reproductive period of the common vole on 14 commercially used grassland fields. Regular life-trapping sessions which followed a capture-mark-recapture design were conducted from June to November 2014 on treated and untreated (control) grassland fields, as well as in adjacent habitats. At the same time, the sporadic occurrence of the fungicide was determined and survival rates were determined and analyzed using linear mixed models. Results of the study will be presented in detail in the poster. The results support the fact that field-effect studies, which investigate effects under real use conditions and are included as higher tier refinement option in the EFSA Bird and Mammal Guidance Document (EFSA, 2009), are a useful tool for the higher tier risk assessment, even though no internationally agreed standard protocol for mammal field-effect studies is existing yet.

MO075 Monitoring NSAIDs in carrion and avian scavengers form Spain: preliminary results after diclofenac registration for veterinary use R. Marques, BRC-CSC- UCLM / Grupo de Toxcoloxia de Fauna Silvestre; M. Herrero, Instituto de Investigación en Recursos Cinegéticos (IREC); P.R. Camarero, Instituto de Investigación en Recursos Cinegéticos, CSIC-UCLM-JCCM / Grupo de Toxcoloxia de Fauna Silvestre; I.S. Sanchez-Barbud, UCLM-CSIC / Grupo de Toxcoloxia de Fauna Silvestre; R. Varela, J. Marches, UNED.

The serious impact of diclofenac on Asian vultures raised the alarm of the deficient environmental risk assessment of some veterinary drugs. In the case of diclofenac, there was an evident gap in the knowledge of the high toxicity that this non-steroidal anti-inflammatory drug (NSAID) has in Old-World vultures that can feed on treated livestock (LD50 = 98-225 μg/kg body mass). Avian scavengers (vultures and similar) can be killed by diclofenac in Asia, in 2013 this drug was authorized for use in veterinary medicine in Spain and other countries in the European Union with the consequent risk of repeating the situation generated in Asia. In this work, we have studied the presence of NSAIDs in carrion animals (kidney, liver and muscle of pig, n=125) supplied in “maladareas” to feed vultures. We have also studied the presence of NSAIDs residues in tissues of avian scavengers, vultures, n=27) found dead with suspicion of being intoxicated. NSAIDs were detected in tissues of four pigs (3.2%). Low levels of flunixin were detected in liver (4.1 ng/g) and kidney (7.9 ng/g) of two pigs; meloxicam was detected in the liver of one pig (23.8 ng/g); and diclofenac was detected in the muscle of another pig (170.5 ng/g). This level of diclofenac was relatively high, but kidney and liver of the same animal were negative for diclofenac presence. An examination of this muscle sample showed a pale area adjacent to a congestive portion that may correspond to the injection point of the diclofenac in the pig. Flunixin was the only NSAID detected in the studied avian scavengers. Two out of 22 Eurasian griffons (Gyps fulvus) analysed had 530 and 23 ng/g of flunixin in liver, 2.83 ng/g of flunixin in liver but it was diagnosed as an intravenous poisoning at the wildlife rehabilitation center. Lesions in the kidney and visceral gout have not been observed macroscopically or microscopically in 15 Eurasian griffons analysed. Residue levels in carrion and scavengers indicate a limited risk of poisoning, possibly because treated livestock died several hours after NSAID injection. However, veterinary use of NSAIDs can still be a threat for scavengers if veterinarians and farmers ignore the associated risk when treated livestock is used to feed vultures.


Field bee (Apis mellifera L.) are beneficial arthropods that play important roles not only in the food and pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers hypophysemal glands (HPG) which produce proteinic substance to feed larvae and queen. The aim of this study was to validate the different algorithms (including obtaining the material) to conduct the hypophysemal glands development evaluation, in order to select the Method that combines the highest reliability (the smallest technical error), the optimal cost, the least effort and time-consumption. The study was conducted on Honeybees subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSA Journal 2013;11(7):3295). Insects were treated with four different chemicals in 3 to 5 concentrations. The HPG were obtained from 3 bees per test item (in the highest concentration, which did not cause mortality below 50%) and the negative control. Six different approaches for HPG evaluation were tested: - histopathology (HP) of isolated glands (linear and quantitative measurements, imaging); - histopathology (HP) of whole heads (linear and quantitative measurements, imaging); - whole mount (WM) method on isolated gland (linear and quantitative measurements, imaging); - protein absorbance (PA) from isolated glands (quantitative measurements); - protein absorbance (PA) from whole heads (histopathology); - scanning electron microscopy (SEM) (linear and quantitative measurements, imaging). The linear measurements (small and big axis of symmetry) were taken from ten acini from left and right HPG, however for SEM only left HPG were included. The quantitative measurements (number of acini per 1 mm²) were taken during HP, WM and SEM testing. The quantitative measurements of protein absorbance from isolated glands were taken from head and right HPG. Analysis of the results showed decreases and increases of acini and protein absorbance depending on the test item. However, observed deviations did not show any statistical significance. According to the performed studies for evaluation of hypophysemal glands development the linear measurement combined with imaging should be used.

MO077 Bird and mammal focal species for pesticide risk assessment in rice M. Vallon, C. Dietzen, S. Laucht, F. Sotti, J. Ludwigs, Rifcon GmbH

Ecotoxicological risk assessment for birds and mammals is required for the registration of pesticides in Europe to assess potential risks to wildlife through consumption of contaminated diet items. To ensure a realistic and reliable risk assessment, bird and mammal focal species should be used that are representative for the species actually occurring in the crop of concern. However, in the relevant guidance document on bird and mammal risk assessment by the European Food Safety Authority (EFSA), rice is to date pooled with other cereals such as wheat and barley, despite the obvious peculiarity of rice cultivation. The generic focal species typically used also in the right HPG and SEM analysis of the results showed decreases and increases of acini and protein absorbance depending on the test item. However, observed deviations did not show any statistical significance. According to the performed studies for evaluation of hypophysemal glands development the linear measurement combined with imaging should be used.

MO078 Bird and mammal focal species for pesticide risk assessment in rice M. Vallon, C. Dietzen, S. Laucht, F. Sotti, J. Ludwigs, Rifcon GmbH

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Non-invasive assessment by feathers of lead exposure and its relationship with stress hormones in bearded vultures from the Alps

R. Mateo, IREC-CSIC-UCLM / Grupo de Toxicología de Fauna Silvestre; L. Giménez-Lozano, IREC Instituto de Investigación en Recursos Cinegéticos; L. Monclus, UAB; I. Chamypp, ASTERS; M. Lopez-Bejar, UAB

A reintroduction project of bearded vulture or lammergeier (Gypaetus barbatus) has been carried out in the Alps since 1987. There are several factors that can affect the success of reintroduction projects and one of the threats is lead (Pb) poisoning. Lead is a toxic metal that accumulates in the skeletal system, and it can be transferred from mother to offspring through eggshell membranes, which makes it an important threat for the survival of the offspring. The aim of this study was to assess the Pb burden in the bearded vultures nesting in the Alps and to study its potential relationship with stress hormones (cortisol, adrenocorticotrophin hormone, and thyroid hormones). The results showed that the Pb burden in the bearded vultures was lower than in other European populations, but it was still higher than the threshold level for Pb poisoning. The study also revealed that the Pb burden was negatively related to the levels of stress hormones, indicating that Pb exposure may have a physiological impact on the birds. The results of this study highlight the importance of monitoring Pb exposure in bearded vultures and the need for further research on the effects of Pb on the health of these birds.

Organohalogenated contaminants (OHCs), due to their Apex trophic position. Their diet consists mainly of fish and seabirds, thus long food chains and a high potential for biomagnification of OHCs. The nestlings can therefore be exposed to high levels of certain OHCs through maternal transfer to the eggs, and later through diet. Concentrations of per- and polyfluoroalkyl substances (PFASs) have recently been shown to exceed those of other legacy OHCs in this species and accordingly required closer observation. Some of the POPs have been found to accumulate in plasma, on thyroid hormones (TH) of nesting white-tailed eagles. We also included the body mass and age to assess influence of biological variables on the TH. Blood plasma samples were obtained from 70 nestlings of white-tailed eagles from two archipelagos in Norway, Smøla (n = 35) and Steigen (n = 35), in the summer of 2015 and 2016. In total, 14 polychlorinated biphenyls (PCBs), 7 organochlorinated pesticides (OCPs), 5 polychlorinated diethyl ethers (PBDEs) and 8 PFASs were quantified in over 50 % of the plasma samples at each location and each year. Our results show higher OHC concentrations in Steigen [median and range; ΣPCBs: 5.1 ng/ml (1.5 – 59.1 ng/ml), ΣOCPs: 4.2 ng/ml (1.3 – 52.2 ng/ml), ΣPBDEs: 0.3 (< 0.1 – 2.6 ng/ml) and ΣPFASs: 20.8 ng (7.2 – 52.9 ng/ml)], than Smøla [median and range; ΣPCBs: 3.9 ng/ml (0.8-34.7 ng/ml), ΣOCPs: 2.4 ng/ml (0.9 – 15.3 ng/ml), ΣPBDEs: 0.2 (1.1 – 1.5 ng/ml) and ΣPFASs: 4.6 (4.6 – 46.7 ng/ml)]. The analyses of thyroid hormones have been carried out and the results will be presented at the conference, along with biological parameters and OHCs.

MO081

Assessment of exposure and effects of Hg levels in feathers of White-tailed eagles (Haliaeetus albicilla) and Northern goshawks (Accipiter gentilis) nestlings from Norway

P. Gómez-Ramírez, University of Murcia / Department of Toxicology; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; G.S. Eggen, Norwegian University of Science and Technology / Biology; J. Eulaers, University of Antwerp / Biology; G. Leopont, University of Antwerp / Department of Oceanology; J.M. Pérez-García, University of Leida / Department of Animal Sciences; T.V. Johnsøen, Norwegian Institute for Nature Research NINA; A. García-Fernandez, University of Murcia / Sociosanitary Sciences; V. Jaspers, Norwegian University of Science & Technology / Biology

Anthropogenic activities have led to a global increase of Mercury (Hg) in the environment. Due to its toxicity, legislative measures have been taken to reduce the levels. To assess the effectiveness of such restrictions and the current levels of these chemicals in the environment, biomonitoring using birds is very useful. Hg has caused detrimental effects in birds such as haematotoxicity, immunotoxicity and endocrine disruption e.g. suppression of baseline corticosterone. The aim of this study was to assess the exposure to Hg and its effects at the biomarker/physiological level in white-tailed eagles (Haliaeetus albicilla) and Northern goshawks (Neoglaux melba) nestlings from Norway. Samples were obtained in 2014 from nesting WTE (n=14) and NG (n=11) in northern Norway (Nordland-N 68.30 – 68.47°, E 24.54 – 25.27°- and Troms-N 68.67 – 67.39°, E 20.39 – 23.34°- counties, respectively). Total Hg in feathers, total and free plasma corticosterone levels were analysed, along with following blood clinical chemical parameters (BCPs): albumin, calcium, phosphorus, lactate, uric acid, and aspartate aminotransferase (ALT), alanine aminotransferase, alkaline phosphatase, cholesterol, triglycerides, creatinine, amylase, glucose, creatinine, bilirubin, potassium and uric acid. Stable carbon (13C, 2H) and nitrogen isotopes ([15N, 14N] were analysed in feathers to evaluate inter- and intra-specific contaminant exposure. Due to the low amount of feather samples, Hg could only be analysed in 13 WTE and 8 NG. Mean ± SD were 51.5 ± 0.34 mg/kg in NG and 3.01 ± 1.34 mg/kg in WTE. The significantly higher levels in WTE than in NG (T(21) = 7.61, p < 0.01) may be related to different dietary input, as confirmed by stable carbon and nitrogen isotope analysis of body feathers. The marine prey of WTE seem to determine the Hg loads, as Hg is known to be abundant in the marine environment. Despite the relations between Hg and biochemical parameters (corticosterone, BCPs) showed relations between Hg and aspartate aminotransferase (an enzyme that may increase after liver damage). The effect of mercury on this enzyme seems controversial, as some experimental studies on nestlings of different species have found both positive and negative relations. Moreover, the lack of information on reference values in GH and WTE complicates the interpretation. Acknowledgements: NLS Science and Sustainability.

MO082

Thyroid-related gene expression, hormones, and thyroid gland histology in American kestrels exposed in ovo to two persistent organic pollutants, SCCPs and TBBPA-BDBPE

A. MacLeod, University of Maryland, College Park / Environmental Science and Technology; P.F. Henry, U.S. Geological Survey / Patuxent Wildlife Research Center; K.J. Fennve, Environment & Climate Change Canada / Ecotoxicology and Wildlife Health; N.K. Karouze-Renier, USGS Patuxent Wildlife Research Center /
Patuxent Wildlife Research Center

Highly brominated flame retardants are being replaced by alternative flame retardants such as Tetrabromobisphenol A bis[2,3-dibromopropyl ether] (TBBPA-BDDBPE). TBBPA-BDDBPE was introduced as a possible substitute for decabromodiphenyl ether (decabDE), but has shown similar persistence and environmental transport mechanisms. This additive flame retardant is used in plastics, paints, textiles, fabrics, and household electronics. Although it is produced only in the US, Israel, and China, TBBPA-BDDBPE is detected in environmental samples and wildlife tissues from around the globe. Short-Chain Chlorinated Paraffins (SCCPs) are priority emerging persistent organic pollutants (POPs) identified as chemicals of concern by the Stockholm Convention, Environment and Climate Change Canada, and the U.S. Environmental Protection Agency. SCCPs are used in metal lubricants and coolants in metal cutting, and as plasticizers and flame retardants in plastics and paints. SCCPs are of concern because they bioaccumulate in wildlife and humans, are environmentally persistent, transported globally, and are toxic to aquatic organisms at low concentrations. However, few data are available on the potential adverse effects of TBBPA-BDDBPE and SCCPs in birds. A comparative exposure assessment of these two classes of flame retardants was conducted using egg injections in a non-model species, the American kestrel (Falco sparverius) to assess survival, molecular, biochemical, and endocrine, growth and reproductive endpoints. Analyses conducted on tissue samples from hatchlings included thyroid related gene expression in the liver, thyroid hormone levels, and thyroid gland histology. Preliminary results will be presented from the molecular to biochemical to cellular level.

MO083
Bioaccumulation of metals in bats: non-lethal vs lethal sampling to assess risk
J. Alves, R. Mina, A. Alves da Silva, CFE - Centre for Functional Ecology / Department of Life Sciences, University of Coimbra; T. Natal de Lobo, University of Coimbra / Department of Life Sciences, University of Coimbra; P. Barros, CITAB - Centre for Research and Technology of Agro-Environment and Biological Sciences / Laboratory of Applied Ecology, University of Trás-os-Montes e Alto Douro; C.J. Topping, Aarhus University / Department of Bioscience; J. Sousa, University of Coimbra / Department of Life Sciences

More than 22% of bat species are threatened according to the World Conservation Union. Among the reasons responsible for this decline are the environmental changes due to anthropogenic factors, namely habitat loss through agriculture, forestry, urbanization and industrialization, contamination by pesticides and metals, changes in water quality. There is a growing concern about the possible consequences of environmental contamination in several bat species. Until now, most of the studies on potential impacts of contaminants, both organic and inorganic, on the global metabolism and survival in bats are based on invasive techniques, such as lethal sampling methods. The aim of this study was to evaluate the potential risk of metal contamination in bat species occurring in Portugal, and to evaluate the suitability of non-lethal sampling methods. The concentration of As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Se and Zn was measured in two categories of biological samples (n=20 - lethal samples: liver, heart, bone and brain; and non-lethal samples: wing membrane and fur) collected from bat carcasses of four different species (Hypsugo savii, Nyctalus leisleri, Pipistrellus pipistrellus, Pipistrellus pygmaeus). Concerning the metal concentration obtained in each sampling tissue, significant differences were found between the concentrations obtained in each species for all the metals (P<0.05), except for Zn (P=0.223). Significant differences were also found between the concentrations of metals in the organs and metals (P<0.001). Depending on the metal, the organ/tissue that showed the highest concentrations varied, but even so far and wide presented the highest concentrations of most of the metals. These results support the hypothesis that non-lethal samples may be useful for studies on wildlife ecotoxicology, and may help to define a protocol capable of being applied at large-scale, to investigate the risk of metal accumulation for bats. For this purpose, non-lethal samples are the best option, and as demonstrated by this study can yield reliable results. Our results therefore provide valuable insights for development of further studies, aiming to understand the importance of metals as a cause for some of the observed declines in bat populations worldwide.

MO084
Metallc element composition of egg contents and eggsHELLS of the Kelp Gull
Larus dominicanus
J.D. van Aswegem, North West University (Potchefstroom Campus) / Unit for Environmental Science and Management; L. Nel, N. Strydom, Nelson Mandela University; H. Brown, North-West University / Unit for Environmental Science and Management

The Swartkops River Estuary near Port Elizabeth, South Africa, is an important recreational, industrial, residential, and ecological asset, but under severe pressure. Seabirds are good indicators of trace elements within their environments. Seabirds are a recreational, industrial, residential, and ecological asset, but under severe pressure. The Swar...
Sensitivity of freshwater pearl mussel juveniles (Margariadina margaritifera) to different environmental and contamination factors

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Margariadina margaritifera is a freshwater bivalve mollusk threatened with extinction in Europe. The population of this freshwater pearl mussel has declined by 90% in Europe, during the XIXth century because of pearl fishing and from the XXth century due to habitat degradation, decrease in water quality and pollution. Nowadays, french population of M. margaritifera is estimated at 100,000 individuals with the largest population found in the river Dordogne (Bordeaux - FRANCE) with up to 15,000 individuals. Freshwater pearl mussels are considered as an excellent indicator of aquatic ecosystem health since they require high water quality and they filter up to 50 L of water a day. As a result, they are called «umbrella species», meaning that their conservation will benefit all species living in the same river. With the aim of preserving this pearl mussel, the European project LIFE «Preservation of Margariadina margaritifera and restoration of river continuity of the Upper Dordone river 2014-2020 » has been set up in which a farm was created in order to produce juveniles in captivity. Some of them will be reintroduced into the environment while others will be used for ecotoxicological studies. The aim of this work was to determine the sensitivity of M. margaritifera juveniles to different environmental and contamination factors, since they are considered as the most sensitive lifestyle of this species. Acute toxicity tests were carried out on one-year-old juveniles in order to determine toxicity thresholds (LC50) of several factors such as temperature, dissolved oxygen, nitrates, phosphates and metals. Those data will allow to target reintroduction areas of juveniles produced in the farm and help the conservation strategies of Margariadina margaritifera in the Upper Dordogne river.

MO087

Using population modelling to reduce uncertainty - an example of a herbicide

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; M. Fouadoulakis, Dow Agrosciences / RSRA ERS

Uncertainty is perceived as a major acceptability criterion for higher tier risk assessment. While uncertainty does not start to be present at the higher tier (though it is generally not considered in the first tier) it needs to be addressed explicitly when higher tier refinements are applied which make the risk assessment more realistic. The use of standard higher tier refinements or even modelling is sometimes perceived as increasing uncertainty. However, in the present poster we demonstrate that refinements and population modelling help to reduce uncertainty by providing additional insight into the mechanistic understanding of risk and the ecological relevance of effects. This is done based on a risk assessment for a herbicide. It is shown how what-if questions help to address specific questions on uncertainty in the risk assessment and how a margin of safety can be calculated.

MO088

SETAC Wildlife Toxicology Interest Group

J.E. Elliott, Environment Canada / Science Technology Branch

LCIA method developments in a global perspective: Status and outlook (P)

MO090

A tool to integrate consumer and environmental exposure in life cycle impact assessment

O. Jollivet, University of Michigan; L. Huang, University of Michigan / Dept of Environmental Health Sciences; P. Funke, Technical University of Denmark / Quantitative Sustainability Assessment Division

Direct exposure of consumers to chemical ingredients within our daily products is an important pathway that often dominates environmental performance profiles of these consumer products, but has been currently left aside in LCIA toxicity characterization. The aim of the present study is to update and extend the existing framework to consistently incorporate consumer exposure pathways in a way fully compatible with existing LCIA toxicity characterization methods, and to illustrate it via a case study of plasticizer chemicals in building materials. We developed a general a framework and a tool that extends the toxicity assessment to the near-field and consumer exposure assessment and combines it consistently with the USEtox fate and transport model in a way that allows dynamic pathways affecting this resource to be identified. The tool allows to (1) identify how freshwater resources can be defined as an entity to protect within the Area of Protection (AoP) natural resources, (2) describe the resource dimension to the WULCA framework on assessing freshwater use in LCA, and (3) propose a characterization framework to assess the impacts from the identified impact pathways. Freshwater resource has a particular status in LCA resource modeling. First, it exists in the form of three types of resources: flow, fund, or stock. Then, in addition to being a resource for human economic activities (e.g. hydropower), it is above all a non-substitutable support for life that can be affected by both consumption (source function) and pollution (sink function). Therefore, both types of elemental flows (emissions and water consumption) should be linked to a damage indicator for combinations. The case study of DEHP plasticizer in a vinyl flooring shows that starting from a mass of DEHP in products of 82 kg, 0.15 kg will be taken in, mostly by the household users via dust ingestion as a dominant pathway. This leads to intake doses of 0.14 mg/kg/bd for an adult and 0.5 mg/kg/bd for a 3 years old child. Performing a full LCA of the vinyl flooring shows that the 16% of DEHP plasticizer in flooring are associated with dominant shares of impact on human health (41%) and (on a per kg of raw material basis), whereas LCIA covers a dominant contributor to climate change impacts (59%). This case study illustrates well the importance to account for consumer exposure to chemical in product during their use. Final outcome is a consistent and quantitative framework and directly applicable tool to determine factors based on scientific consensus for assessing life cycle exposure and toxicity impacts of chemicals in LCIA, as an input to the LCIA guidance efforts of the Life Cycle Initiative.

MO091

Towards the integration of an Agent-based Model into LCA framework to assess dynamic indoor air quality

A. Micolier, University of Bordeaux / The Life Cycle Group CyVi; P. Loubet, University of Bordeaux / ISM CyVi; F. Taillandier, University of Bordeaux / I2M GCE; G. Sonnemann, University of Bordeaux / ISM CyVi

The construction sector, representing 44% of the total final energy consumption in Europe, is recognized as a major hotspot of resource use and environmental impacts. Thus, strong efforts are made to encourage the design of environmentally friendly buildings. However, the air quality of low energy buildings has created particularly confined and polluted indoors. Indoor pollution has been raised as a major public health issue since we spend on average 80% of our time in closed spaces. Designing sustainable buildings with good indoor air quality is even more challenging since this latter is strongly influenced by occupant’s lifestyle and behavior. Life-cycle assessment (LCA) is a relevant methodology to account for impacts from indoor air while avoiding potential burden shifting from the life cycle of energy or material LCA used. Nevertheless, the current use of LCIA may face scientific obstacles such as: (a) the inclusion of the dynamical effects of indoor pollution on human health and (b) the consideration of the behavior of the occupants. In order to address these concerns, a model of autonomous agent has been developed structured around (i) an agent-based model Li-BIM (Live in BIM) which explicitly represents human behavior; (ii) a physical model to capture the building thermal behavior; (iii) the numerical representation of the building (BIM) and (iv) an innovative indoor air quality model Be-BIM (Breathe in BIM). Li-BIM is an operational model which simulates the behavior of the occupants based on an evolved occupational cognitive and social framework. Be-BIM is currently being developed as a dynamic and localized fate model sensitive to users’ behavior and the building thermal dynamic of a building. The Li-BIM model will gather the inventory data for dynamic pollutant emissions and (ii) assess the local impacts from air emissions. Expected outcomes of our integrated model include characterization factors for human toxicity due to indoor air which are dynamic and spatially differentiated at the scale of the building. Eventually, our model will allow the comparison of life cycle impacts of different building scenarios with a specific focus on indoor air quality suited for residential dwellings.

MO093

Adding the resource dimension to the WULCA framework on assessing freshwater use in LCA

C. Pradinaud, IRSTEA Montpellier / ITAP ELSA; S. Northeby, Monash University; B. M. Amor, Université de Sherbrooke / Département de génie civil; J.C. Bare, U.S. Environmental Protection Agency / National Risk Management Research Laboratory; L. Benini, European Environment Agency; M. Berger, Technische Universität Berlin / Chair of Sustainable Engineering - Office Z1; A. Boulay, CIRAIG - École Polytechnique de Montréal / Chemical engineering department; A.D. Henderson, Noblis Inc / Environmental Science; G. Junqua, École des Mines d’Alès / LGEI; M.J. Lathuilière, University of British Columbia / IRES; M. Margui, CIRAIG - École Polytechnique de Montréal / Mathematical and Industrial engineering; M. MOTOSHITA, National Institute of Advanced Industrial Sci. and; B. Niblick, U.S. Environmental Protection Agency / Life Cycle and Decision Support Branch; S. Payen, AgResearch; S. Pfister, ETH Zurich; P. Quinteiro, University of Aveiro / Department of Civil Engineering; T. Sonderegger, ETH Zurich; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Isetra / UMR ITAP Effective management of freshwater resources is recognized as being vital. At present, existing LCIA methods for water use do not entirely reflect the scale of such a vital resource remaining for future generations. Thus, the objectives of this study are to (1) identify how freshwater resources can be defined as an entity to protect within the Area of Protection (AoP) natural resources, (2) describe the impact pathways affecting this resource, and (3) propose a characterization framework to assess the impacts from the identified impact pathways. freshwater resource has a particular status in LCA resource modeling. First, it exists in the form of three types of resources: flow, fund, or stock. Then, in addition to being a resource for human economic activities (e.g. hydropower), it is above all a non-substitutable support for life that can be affected by both consumption (source function) and pollution (sink function). Therefore, both types of elemental flows (emissions and water consumption) should be linked to a damage indicator for...
freshwater as a resource. In order to clearly define what is to be protected, the freshwater resource is put in perspective through the lens of three safeguard subjects. Considering the current scope of the AoP natural resources, the complex nature of freshwater resources and the dimension of freshwater to safeguard, a definition of freshwater resource is proposed. Also, a wide range of possible impact pathways to freshwater resources is identified, establishing the link between direct and indirect pathways to the long-term from the short-term to cause freshwater depletion or pollution in the long-term. The concept of recovery period is used to operationalize this framework: when the recovery period lasts longer than a given period of time, impacts are considered as being irreversible and fall into the concern of freshwater resources protection (i.e. affecting future generations). The study shows that it seems relevant to include this concept in the impact assessment stage in order to discriminate the long-term from the short-term impacts, as some dynamic fate models already do. Recommendations are also given for freshwater resource impact indicator(s). Therefore, such an indicator would allow LCIA to capture potential long-term impacts that could transparently advise decision makers about potential safe water supply issues in the future.

MO094 Considering water and soil conservation works in Life Cycle Assessment: focus on contour ridges and erosion impacts
M. Jouini, Montpellier SupAgro / Département de génie rural; R. Campanlini, IRD; UMR LISAH; S. Folliain, Montpellier SupAgro, UMR LISAH; J. Burte, CIRAD / UMR GEAU; N. Benaisa, National Agricultural Institute of Tunisia / Science de la production Animale et Planteurs; F. Ovchar, Montpellier / ELSA Research group and ELSA-PACT Industrial Chair
Soil is a rare natural resource and it is at the center of the main issues in agronomy, environment and land use planning. At global level, erosion is one of the major soil degradation processes and it is responsible for the decrease in agronomic potential of soils and in agricultural land surfaces. Water and soil conservation works (WSCW) are built to protect soil from erosion. The financial and environmental cost the WSCW construction is very high. However, the positive impacts of WSCW are not taken into account in Life Cycle Assessment (LCA). The objectives of this study is to intergrate the impact of WSCW on soil quality in LCA. There are different types of WSCW with different functions and they act differently on erosion process. In this study we focused on contour ridges as a type of conservation works because they are associated to crop systems. Contour ridges are generally built in upland areas to reduce runoff and erosion, to increase on-site deposition of eroded particles and to increase local water infiltration. Contour ridges modify water and soil flows at catchment scale, so it is necessary to use a model able to calculate the inventory flow at the catchment and not only at the plot level. In this study we present a methodology to integrate the impact of contour ridges on topsoil erosion at the catchment level and to compute characterization factors in presence of such WSCW. The proposed method was applied in a case study in semi-arid context in central Tunisia (Merguellil watershed) which presents the issues of over-exploitation of water resources, accelerated land degradation and a high expansion of conservation works. In order to highlight the impact of WSCW on topsoil erosion, a Hargreaves equation was used to simulate the potential of such WSCW. The study shows that it seems relevant to include this concept in the impact assessment stage in order to discriminate the long-term from the short-term impacts that could transparently advise decision makers about potential safe water supply issues in the future.

MO095 Impact of heavy metals on human toxicity using LCA: a case study for Wallonia
S. Gerfinet, Université de Liège / Chemical Engineering; F. Van Stappen, CRAW Walloon Agricultural Research Centre; S. Belboom, ULiege; E. Pezennec, Knauf Insulation sprl.; S. Groslandem, University of Liège - Chemical Engineering / Dpt of Chemical Engineering - PEPs; A. Leonard, University of Liege
The study aims at assessing the resulting human toxicity of corn farming in Wallonia, Belgium. The USEtox method is applied to the farming of one hectare of corn. Local data are used for farming data and GaBi databases are used for background data. The field emissions due to farming are calculated by the most used models. The results in human toxicity, cancer effect, underlie the large contribution of chromium (Cr) emissions due to the use of organic and mineral fertilizers. But despite the emission of chromium, the chromium in the corn is measured and therefore, unspecified chromium is used as emissions. However, it is known that the chromium in natural environment is most probably Cr (III) and this could really decrease the impact as the specification factor for unspecified chromium, is, in USEtox, the average of the one of Cr (III) (non-toxic) and Cr (VI) (toxic), therefore really larger than the one of Cr (III). Therefore, a test is realized where the Chromium is divided by 2 and the rest is Cr (VI). In this case, score in human toxicity cancer effect is divided by 2, whereas this has no influence on the other results. The impact for human toxicity, non-cancer effect is mostly related to zinc emissions in soil due to the use of organic fertilizers, especially pig manure. However, zinc is abundant and is an important trace element in the human body. It is useful for growth, bone and brain development, etc. and the European Commission recommends the consumption of 7-10 mg of zinc by person and per day. Moreover, mammals are able to eliminate zinc, therefore they are able to maintain a constant level of zinc independently of the exposure level. Consequently, only the exposure to high doses can have toxic effects. A test was made to determine the characterization factor of zinc equal to 0 in the USEtox model. In this case, the corn cropping obtains a human toxicity, non-cancer effect divided by 12 compared to the base case and mostly related to lead and mercury emissions in the soil. In both case, the contribution of pesticide is negligible. In conclusion, although the uncertainties about toxicity categories are well-known, this case study underlines the impact of the user hypotheses and shows that a detailed analysis of the results is essential for a critical view on the toxicity results.
Impacts of Chemicals
R. Calvo-Serrano, G. Guíllén Gosálbez, Imperial College London / Chemical Engineering

Process sustainability has become one of the fundamental criteria for decision making in chemical industry, being Life Cycle Assessment (LCA) the most popular method in recent years, currently being one of the most extended sustainability assessment methods. Since LCA is based on the analysis of all interactions for all the stages of the life cycle, it ends requiring large amounts of information. This information, however, can be difficult or impossible to gather, being one of the main obstacles when trying to apply LCA. Chemical industry is particularly affected, easily having thousands of interactions even for small and relatively simple processes and only information of a few hundreds. In these cases, when a full LCA cannot be applied, a simplified version is used instead. These streamlined LCA (SLCA) follow the same basic as LCA, but generally either simplify the scope of the analysis and/or reduce the amount of information required in the assessment.

The precise simplifications to be done (and the assessment discrepancy with the full LCA) have to be specifically considered for the process or activity assessed. Under these principles, we present a novel approach for the estimation of LCA impact categories associated to the production of chemicals using information of their chemical and physical properties. We propose that the physical properties of the products are directly related with the impacts generated in the production process, and that these impacts heavily contribute to the overall impact generated for the production of the chemical analysed. Previous studies demonstrated the prediction capabilities of molecular and thermodynamic attributes. Here we also consider the impact factors as attributes, for a better characterization of the chemicals and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP) (3.35%) or Eco-Indicator99 (EIP99) (18.34%).

MO100 Development of USEtox characterisation factors for micropollutants in effluents
E. Maillard, ELSA-PACT Industrial Chair
Many substances are increasingly detected in surface waters, after their use by the human population. In most cases, these substances will exert the same effects as desired when they are originally applied, only now affecting different organisms. These effects can occur at concentrations of μg/l, which is why these substances are called micropollutants. In the context of Life Cycle Assessment, there is a need for characterising the toxicity potential of these micropollutants affecting ecosystems and/or the human population. A substance which is not characterised will not be considered in a LCA study, which may result in misguided decisions and the omission of essential environmental issues related to biodiversity and human health. The aim of this project is to develop a database of characterisation factors for the most chemicals as attributes, for a better characterization of the chemicals and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP) (3.35%) or Eco-Indicator99 (EIP99) (18.34%).

MO101 Adjustment of freshwater ecotoxicity with USEtox
M. LOT, CEHTRA; P. Thomas, CEHTRA SAS; F. Sahigara, KREATIS; M. Jacob, TOTAL SA
USEtox is determined as the reference tool for freshwater ecotoxicity impact evaluation in LCA context. By the way, it is recommended by several institutes: by European Commission for PEF/EOF project, by JRC-IES in ILCDB handbook, by WZL for the characterization of chemicals and by US-EPA in TRACI tool manual. An assessment of the relevance of the Characterisation Factor (CF) with its associated factors was realized. We found that CF appears to be significantly influenced by the effect factor (EF), implying that the 2 others factors, XF ( Exposure Factor) and FF ( Fate Factor), do not intervene, or very little, in the final calculation of CF. This finding is surprising because the XF and FF factors should influence the calculation of CF as they represent, significant fate adjustments: substance bioavailability (XF) and its presence in the medium (FF).

Hence, the influence of each factor was analysed in more detail and some inconsistencies were noted. For EF, USEtox includes an extrapolation calculation for acute to chronic toxicity (called Acute-to-Chronic Ratio). This extrapolation is not always reliable and will certainly not be applicable for substances with a low log Kow<6 where acute toxicity is superior to solubility but chronic toxicity may still occur. Moreover, the value used for the ACR seems inappropriately low and should be different according to the mode of action of the substance. For XF, adsorption starts to reduce XF at log Koc around 5 whereas adsorption of organic substances is generally considered to become highly significant in ecotoxicological studies performed at low concentrations from log Koc of 4. Overall, the XF seems to be overestimated in this model for the majority of substances with a log Kow between 3 and 5. For FF, one of the parameters that most influences its calculation seems to be the biodegradation, which alone can alter the relationship between the EF and the CF by an order of magnitude (between a highly persistent and a highly biodegradable compound). However, the relative influence of biodegradation (and the other FF parameters) on the CF is too limited compared to the EF value. Indeed, the difference between the minimum and maximum biodegradation on CF is approximately 2 orders of magnitude while the EF itself spans at least 8 log units. Thus, because of these inconsistencies, it is crucial to discuss the relevance of each factor with the aim of improving the model providing a more realistic approach.

MO102 Advancing nutrient modelling in eutrophication methods for life cycle impact assessment

Anthropogenic contributions of the nutrients nitrogen (N) and phosphorus (P) threatens the health of freshwater and marine ecosystems around the world [1]. The increase in environmental nutrient availability, known as eutrophication, can lead to harmful algal blooms (HABs) and decreased levels of oxygen (hypoxia) needed to sustain aquatic life [2]. This presentation evaluates the current state of life cycle impact assessment (LCA) methods for eutrophication in freshwater and marine ecosystems using a criteria-matrix review of the underlying fate and transport (F&T) models. Results of the review point to several key recommendations for further scientific development of midpoint eutrophication methods in life cycle assessment (LCA). Current eutrophication methods in LCA are limited. Most LCA methods use simplified F&T models with continental or global geospatial resolution, characteristics of which tend to be inadequate for regional analyses and complex community-based decisions. Therefore, this critical review examines a set of surface water quality models, watershed models, marine models, and air quality models that each have potential for integration into LCIA. Factors examined include sources of nutrient loading to each environmental compartment (e.g., water quality models, land use, point sources, non-point sources, etc.), and the representation of each F&T mechanism. Review results suggest several possible recommendations, including the continuation of the recent trend toward separation of freshwater and marine eutrophication methods, expanded characterization of the freshwater cause-effect chain, and the development of new soil and freshwater fate factors. By incorporating findings of the F&T models into current eutrophication methods, LCA can better inform scientific decisions that affect water quality, nutrient management, and environmental policies across watersheds and global ecosystems. [1] Rockström J, Steffen W, Noone K, Perrson Å, Chapin FS, Lambin EF, Lenton TM, Scheffer M, et al. 2009. A safe operating space for humanity. Nature 461: 472-475. [2] Diaz RJ, Rosenberg R. 2008. Spreading dead zones and consequences for marine ecosystems. Science 321: 926-929. Disclaimer - The views expressed in this paper are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

The topic of ‘water’ in LCA has emerged as an important approach to quantify the related effects of water use from consumption of goods and services. Several assessment methods have been proposed by the scientific community, encompassing both the computation of water use and its impacts, but differing in their contents of water systems and in the methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: i) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relative Available Water Remaining per area in a watershed.

MO105 Identification of methodological challenges remaining in the assessment of a water scarcity footprint

P. Quinteiro, University of Aveiro / Department of Environment and Planning; b. Radoutt, CSIRO; L. Arroja, A. Dias, University of Aveiro / Department of Environment and Planning

Freshwater stress and its implications for present and human welfare and the natural environment awakened the need to develop spatially explicit methods to calculate the product water footprint (WF) from a life cycle perspective. In this sense two parallel developments appear: i) a water footprint assessment (WFA) developed by the Water Footprint Network (WFN) to map direct and indirect water use along supply chains and its relevance in water resources management; and ii) an impact-based WF following the life cycle assessment (LCA) methodology, according to the ISO 14046. Both WFN and LCA-oriented impact assessment methods considers blue water (fresh surface and groundwater) and green water (rainfall on land that does not run off or saturate groundwater). After that, both methods continue the state-of-the-art of the methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: i) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relative Available Water Remaining per area in a watershed.

MO106 Filling the Gap of Overfishing in LCIA: Eco-factors for Global Fish Resources

M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Sciences; L. Eynmann, ETHZ Swiss Federal Institute of Technology; B. Keller, R. Itten, Zurich University of Applied Sciences / Institute of Natural Resource Sciences

There is a lack of LCIA methods to assess the contribution of fish consumption to the global problem of overfishing. Due to this methodological gap, fish is often determined to have a lower environmental footprint than other sources of animal protein in LCA studies. The aim of this publication is to present the development of eco-factors for fish resources and by-catch as an addition to the Swiss Ecological Scarcity Method 2013 and to compare the eco-factors of different fish resources and the impacts of fishing as well as the impacts of dietary alternatives like chicken, pork, lamb, beef and veal. The sustainable use of fish resources ensures that the fish stock for each fish species exceeds the minimum stock needed for a sustainable yield. Therefore, the method developed uses a distance to target approach based on the fish stock for maximum sustainable yield (FS_{MSY}) and the current fish stock (FS) for the characterisation of the use of fish resources. The eco-factors were calculated for each fish species and fishing area. The inclusion of the eco-factors shows the relevant contribution to the total environmental impact of fish compared to fishing and fish processing. Depending on the fish species, fish can have significantly higher overall impacts compared to different types of meat. The contribution of the eco-factors for by-catch is minor compared to fish resources but still relevant for the comparison with dietary alternatives. Distance to target based eco-factors using regionalised data for FS and FS_{MSY} not only follow a comparable underlying approach as suggested in literature but also enable aggregation into a single-score with other environmental impacts. The overexploitation of fish resources is highly variable for different fish species and fishing areas as well as for by-catch. When comparing fish to equivalent dietary alternatives like chicken, pork, lamb, beef or veal, consideration of the overexploitation of fish resources results in some fish species exceeding the environmental impact of dietary alternatives. Therefore, the overexploitation of fish resources is relevant in the Life Cycle Assessment of fish products in different diets. The state-of-the-art approach can be extended to a full single-score LCIA of meals and is able to reflect the regionalised impacts caused by the overexploitation of fish resources.
freshwater eutrophication due to nitrogen as well as phosphorus emissions from wastewater treatment plants (WWTPs) and agriculture on the global scale. CFs were defined as the change in potentially not occurring fraction of species (PNOF) due to a change in the river basin-specific emission of P or N to freshwater (via WWTPs) or agricultural soil and consist of a fate and an effect factor. To determine the fate factors, the change in N and P concentrations resulting from agricultural as well as from WWTP emissions year 2000 compared to year 1990 were separately modeled for every river basin in the world. Effect factors were based on log–log–logistic relationships between the PNOF (dimensionless) of heterotrophic species and total P (TP) or NO3– concentrations. The PNOF – concentration relationships were determined using data on the highest concentration where a species was observed in field surveys. Our work provides the opportunity to quantify worldwide spatially-explicit a priori eutrophication impacts due to nitrogen as well as phosphorus from soil as well as from freshwater emissions, in a coherent way. The factors can be applied to determine eutrophication impacts of products in LCIA, as well as to determine country-specific eutrophication footprints using multi-regional input-output (MRIO) analysis.

Building of large-scale inventories of emissions and resources and applications for environmental footprints of territories, nations and sectors (P)

MO109 Carbon and material footprint of consumption in Flanders - an input-output based assessment
A. Vercalsteren, VITO NV; K. Boonen, M. Christis, VITO; E. Vander Putten. VMM-MIRA

Environmental footprints of a country or region are a measure for the environmental impact that is caused worldwide by national or regional consumption. The Flemish Environment Agency (VMM) asked VITO to assess the carbon and material footprint of consumption in Flanders (region of Belgium) and identify hot spots and bottlenecks, based on the Flemish environmentally extended input-output model. The Flemish EEIO model is based on specific monetary and environmental data for the Flemish region of Belgium and is part of an interregional IO-model in which trade with the Brussels and Walloon Region is modelled in IO-tables. Imports from outside Belgium are included via the link with the use table of Exiobase. A monetary consumption matrix for households divides the final demand vector of households in different consumption categories. In 2010 the carbon footprint of Flanders amounted to about 20 tonnes per inhabitant. Nearly three quarters of the carbon footprint are linked to household consumption, mainly caused by the production and transport of the goods and services consumed. Three quarters of the carbon footprint of goods and services purchased by households are linked to housing, food and personal transport. Whilst the majority of the greenhouse gas emissions, primary materials and employment is outsourced, the added value linked to Flemish consumption is mainly created in Flanders. The presentation will introduce the overall results of the carbon and material footprint assessment of Flemish consumption in 2010 and go more in detail into the value chain impact of some household consumption activities e.g. food consumption. The relation between the carbon and material footprint, geographical and sectoral distribution of different production chains and consumption activities, and the relation with added value and employment created by Flemish consumption will be discussed. As the model is available for 2003, 2007 and 2010, the evolution over these years will also be presented. Conclusions will mainly focus on methodological issues and policy implications that follow from this analysis. To achieve the greatest possible global environmental benefit, it is not enough to focus on a country or region’s boundaries alone. There is also a need for a policy that is aimed at making production chains and consumer behaviour more sustainable, including internationally harmonized calculation methods and targets of footprints to evaluate the results.

MO110 A cross-country analysis of relationship between economic structural change and CO2 emissions. K. Shimomita, Kyushu University / Economics; S. Kagawa, Kyushu University; Y. Kondo, Waseda University

In this study, we focus on the effects of changes in material and energy input structure on the life-cycle CO2 emissions (i.e., consumption-based emissions). Previous studies have employed a mostly descriptive structural decomposition analysis including the shift toward a service economy and the increase in greenhouse gas (GHG) emissions embodied in consumptions of a specific country (United States or Japan) (Suh, 2006; Nansai et al., 2009). This study is an important follow-up research that examines the environmental effects across countries and evaluates whether or not the development levels of countries can explain those environmental effects. Specifically, we employed a mutually exclusive structural decomposition analysis based on the World Input-Output Database (WIOD) during 1995 to 2008 (Dietzenbacher et al., 2013) and decomposed life-cycle CO2 emissions of 40 nations into the following four inducement sources: (i) inputs from material goods (including energy) to material goods, (ii) inputs from material goods to services, (iii) inputs from services to material goods, and (iv) inputs from services to services. From the results, we found that the role of inputs from material goods to services and inputs from services to material goods in increasing life-cycle CO2 emissions have become more important than inputs from material goods to material goods in not only developed countries but also developing countries. Services are sustained by manufactured goods, so manufactured goods are necessary for the continued growth of service sectors. In a developed country, a large proportion of its GDP is generated by tertiary sector activities, and the role of service sectors in economic growth will expand more and more. In developing countries too, since the proportion of production from primary and secondary industries will shrink and that from tertiary industries will rise with their economic growth, the importance of service sectors will be enlarged. For this reason, it is essential to focus on the production systems of service sectors to reduce domestic CO2 emissions. It is especially important to sift to the industrial structure with less emission-intensive material goods.

MO111 Influence of substance coverage on impacts from the electricity sector A. Leclerc, DTU / Management Engineering; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering Division for Quantitative Sustainability Assessment; R. Wood, Norwegian University of Science and Technology / Biology; A. Laurent, DTU / Division for Quantitative Sustainability Assessment DTU Management Engineering

The electricity sector is a major source of emissions of greenhouse gas, but also heavy metals, dioxins or radioactive isotopes. However, most environmental assessments of the electricity sector at national or global scale focus solely on climate change and do not include other environmental impact categories such as particulate matter formation or toxic impacts on human health. At the national scale, the few available databases are limited to a narrow substance coverage. For example, official reports of pollutants emissions to the European Monitoring and Evaluation Programme (EMEP) should cover 23 substances in 51 countries, but they are not always complete. The Multi-Regional Input-Output database (ERIOSE) includes emissions from air to 44 countries and 5 regions but only for 33 substances. In comparison, the database Ecoinvent provides emission data for hundreds of substances in the unit process inventories for electricity and heat generation. Here, we aim to develop a globally consistent and extensive dataset of airborne emissions from electricity production to get a more realistic coverage of toxicity impacts in large-scale life cycle assessments (LCAs). We thus built the Ecoinvent-based National Energy-related Emission Inventory (ENEERI) by upsampling processes from Ecoinvent 3.3 with national production volumes of electricity and complementing it with emission data from external sources. The resulting inventory ENEERI covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we showed that using ENEERI may underestimate the toxicity impacts associated with electricity production by a factor ranging from 1.4 to 1.9, while Ecoinvent may cut them off by up to 4 orders of magnitude in some countries. This demonstrates the importance of having an extensive substance coverage to fully represent the environmental impacts of electricity production.

MO113 Mapping the carbon, air pollution, and biodiversity footprints of nations: A GIS + global supply chains K. Kanemoto, Shinshu University / Faculty of Economics and Law; D. Moran, Norwegian University of Science and Technology

"Spatial footprinting" is an approach for locating the actual hotspots where impacts due to carbon consumption are produced. It offers the potential to link any remote sensing or earth observatory GIS data that is tagged to an economic sector to any multi-regional input-output (MRIO) based economic model. We present new method for locating at a subnational level the environmental emissions induced by global supply chains. As the world economy becomes more complex it is increasingly difficult to connect consumers and other downstream users to the origins of their GHG emissions and other impacts. Given the important role of subnational actors in GHG abatement and other environmental protection efforts, it is advantageous to connect consumers to the locations where their purchases are driving environmental pressure. We present spatial footprint results for 187 countries showing the footprint of GHG emissions, air pollution hotspots, and biodiversity threats, and discuss our spatial footprint methodology.

MO114 LCA data machine applied A. Ciroth, GreenDelta; M. Stroeka, GreenDelta GmbH

In any LCA study, finding data sets that are “fit for purpose” is probably one of the aspects which consumes most time and effort, and the data sets which are used have obviously a direct implication on the stability of the result achieved. This high effort for finding and creating data sets is true despite the existence of several comprehensive, generic databases for LCA. It is underlined by the presence of intransparent, outdated, or out-of-region and context data set in these databases. For this reason, an “LCA data machine” has been developed at GreenDelta in the last 3 years, and was already presented earlier at conferences. The LCA data machine automatizes creation, update, and to some extent also review of data sets in LCA and sustainability assessment. Data sets are created to meet several specific requirements, e.g. related to region, time, or nomenclature system, but can also be
created so that they meet requirement sets, such as, for example, related to PEF. Meanwhile, the “DAMA” has been applied to various sectors, products, and data sources. The presentation will summarise key steps of the development and will demonstrate the DAMA, for specific data sets and also for specific use cases. The LCA data machine will be demonstrated in three different application cases: 1) finding and if necessary creating data sets in situations where no data set is directly available, i.e. for data gaps; Paper machine example 2) creating a data set as copy of an existing data set, to adapt to specific, local needs; Creating soy bean production US 3) Product comparison, identification of differences between compared products The approach with DAMA will also be compared to approaches currently used in LCA, with examples from the PEF remodelling project and others. The LCA data machine has the potential to truly change the current approach for data set creation, exchange, and also use, in LCA and related areas and can be especially useful for creating inventories in a larger scale.

MO115 Static and dynamic modeling of high performance buildings: Comparison of average and full life cycle electricity mix, a consequential effect on LCA results
A. Shinde, M. Bilec, W. Collinge, University of Pittsburgh / Civil and Environmental Engineering; H. Rickenbacker, University of Pittsburgh / Civil & Environmental Engineering; A. Landis, Clemson University / Environmental Engineering and Earth Sciences; C. Thiel, New York University School of Medicine / School of Population and Public Health

Tilting on the life cycle assessment (LCA) involves explicit assumptions and major uncertainties associated with the source of electricity across two main dimensions: spatial and temporal. There is a need within the LCA community for an approach that addresses this ambiguity and allocates environmental impacts as a function of marginal and time-specific variations. In our study, particular attention is paid to the dynamic characteristics of two buildings’ electrical energy consumption in relation to the specific power grid time resolutions. Our LCA model incorporates hourly energy use data for on-site renewable production at a net-zero energy building (NZEB), and hourly or sub-hourly electrical energy usage data at a LEED Gold building: both are situated in an energy conservation district located in Pittsburgh, PA. Seven iterations of both static and dynamic life cycle assessment (DLCA) based-models were performed and evaluated based on building energy use (predicted vs. observed), electrical grid time resolution (yearly, monthly, hourly), and region-specific electrical grids and data sources (Environmental Protection Agency, Department of Energy). Our results illustrate that the use of photovoltaics at the NZEB produced excess electricity by on-site renewables which is distributed back to the grid and can be interpreted as avoided upstream emissions (generation at the power plant), which in some cases may offset or erase marginal impacts. The marginal consequential model improved the payback period by an order of magnitude (12.5 years to 3.0 years). Additionally, the dynamic scenarios explored in this study were able to effectively account for the growth in natural gas generation, assigning or ignoring emissions based on a marginal increase or decrease load during the building’s electricity use. The LEED Gold building is solely reliant on the regional electrical grid, making our findings indicative of a market-as-usual scenario and therefore comparable and/or scalable to other building studies. No studies combining time-resolved building electrical usage with time-resolved grid electricity production have been found in a U.S. context. There are notable differences between the European and North American power grids, on that account this approach aids to the advancement of DLCA research domestically.

MO116 Life cycle framework for environmental assessment of public transport systems
A. Shinde, Indian Institute of Technology Bombay, Mumbai, India; A. Dikshit, Indian Institute of Technology Bombay, Mumbai, India / Centre for Environmental Science and Engineering (CESE); R. Singh, Thinkstep Sustainability Solutions Pvt. Ltd., Mumbai, India

Several studies have assessed life cycle environmental impact of public transport systems. However, there is no single platform, software or tool for comparing the environmental benefits and drawbacks of different transportation systems. The objective of this study was the development of an LCA based-framework to evaluate, analyze and compare the life cycle environmental impact of public transport systems. The modular and parameterized system of GaBi 6.5 platform has been used for exploring the life cycle environmental performance of commuting trains, public bus transport and intermediate public transport (IPT) modes viz. taxi, auto-rickshaw. The system boundary comprises the life cycle impact of construction and maintenance of transport infrastructure, manufacturing and maintenance of the vehicle, energy/fuel production and tail-pipe emissions. This framework is capable to characterize the per passenger km travelled (PKT) and vehicle km travelled (VKT) environmental impacts of an existing and proposed project. Since per PKT environmental impact of public transport systems are highly sensitive to ridership levels, the environmental impact of public transport systems and IPT modes has been compared for off-peak, average and peak hour levels of ridership. This framework has been developed on the basis of extensive data collected for the material and energy required for the construction and maintenance of infrastructure, manufacturing and maintenance of rolling stock, use phase impacts of fuel/energy production and tail-pipe emissions, in addition to the transport of raw materials. Therefore, this framework is highly comprehensive but it is also amenable to future additions and expansions. The regional transport authorities can proactively address the target areas for improving the environmental performance of their transportation system, and ultimately the competitiveness of their network. The regulatory authorities will have the information to improve on their policies to reduce environmental impacts associated with each mode at each stage.

MO117 Environmental impact assessment of rail freight intermodality in Belgium using the Life Cycle Assessment methodology
A. L. MERCCHAN, Université de Liège / Chemical Engineering, PEPs; S. Groslandert, Université de Liège / Chemical Engineering; A. Léonard, Liège Université / Chemical Engineering - PEPs

BRAIN-TRAINS is a project supported by the Belgian Federal Government that deals with the possible development of rail freight transport in Belgium, analysing the current situation of the intermodal freight transport from an interdisciplinary perspective. The objective of increasing the rail freight transport is linked to the European Commission’s White Paper on transport (2011), which aims to shift the 30% of road freight over 300 km to other modes of transport more energy-efficient such as rail or waterborne transport by 2030. In the framework of the BRAIN-TRAINS project, the Life Cycle Assessment (LCA) methodology has been chosen to analyse the environmental impact of the intermodal rail freight transport in Belgium. In a first stage we have carried out the LCA of rail freight transport (distinguishing between electric and diesel traction), inland waterways transport and road freight transport independently. In a second stage we have carried out a study of the environmental impacts related to intermodal rail freight transport. For this, we have studied several consolidated intermodal rail-road routes in Belgium. The aim of this analysis is to compare the environmental impacts of these intermodal routes to rail transport, and the initial aim of the related policy is linked to the rail freight development in order to define the sustainability impact of future intermodal transport. They could help in making optimal policy decisions relative to the development of intermodal transport in Belgium, including environmental aspects and allowing the reduction of emissions in the transport sector.

Modelling and monitoring of pesticides fate and exposure in a regulatory context (P)

MO119 Quantifying visual assessment of kinetics - Development of an objective criterion to support visual assessment of SFO fits of parent soil degradation
J. Witt, Bayer AG / Environmental Safety; S. Bouleix, Envisearch Ltd; S. Ford, JSC International Limited; D. Patterson, Syngenta; B. Erzgraeber, BASF SE; M.A. Thomas, Monsanto Company; I. Hardy, Batelle; R.L. Jones, K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; J.A. Hingston, Chemicals Regulation Division

Kinetic evaluation of soil degradation studies for parent compounds is a key step to derive degradation endpoints. For modelling endpoints, single-first order (SFO) kinetics is preferred when acceptable, because it is implemented in exposure models. In presence of some bi- phasic tendency, acceptability of SFO is a recurrent source of discussions in the regulatory context. FOCUS kinetics guidance proposes Chi2err < 15% and visual assessment as decision criteria. However, the Chi2err model misleading as it does not account for systematic deviations, while the visual assessment is inherently subjective. In the framework of a group led by UK CRD, to update FOCUS kinetics guidance, we aimed at finding criteria to quantify visual assessment. We collected 40+ example soil degradation studies that were assessed separately by 4 experts based on visual assessment, using scores between 0 (clearly SFO) and 10 (clearly bi-phasic). Individual scores showed high variability, the necessity of deriving a criterion to support visual assessment. Based on discussion, we derived group consensus scores. Consensus scores showed little correlation with Chi2err (R^2 = 0.23). Among several proposed criteria, the SWARC (scaled and weighted area under the residue curve) criterion showed the best correlation to the consensus scores (R^2 = 0.77). SWARC was specifically developed for this task. The residue curve is split into blocks of the same sign (i.e., over- or underestimating the residual data). The SWARC criterion is weighted depending on the number of residues and summed up. The result is normalised by the study duration; a scaling factor accounts for high deviations from the last data.
point. Thus, the criterion mimicks the visual assessment process, taking into account the presence and size of systematic deviations, and whether the model adequately predicts the last data point, as a measure for extrapolation capacity. We find that SFO fits with SWARC < 40 can be considered clearly acceptable; for higher SWARC values, SFO may still be acceptable (particularly if SWARC < 65), but DFOP should also be assessed. Testing of the criterion for metabolite fits showed that at higher concentrations, it was considered as being not acceptable and also be useful for metabolites. Taken together, we provide a novel tool that quantifies the visual assessment of SFO fits. This can guide decision making and thus help to reduce subjectivity in regulatory assessments.

MO120 "Southside"- Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe

B. Gottesbaeren, BASF SE / Crop Protection, Environmental Fate Modelling; H. Bayer, BASF SE; K. Platzer, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modelling; B. Erzgraeber, BASF SE; P.F. Donaldson, BASF Corporation / AP/EPFR; J. Goulet-Fortin, BASF SA; F. Kröger, Eurofins Agroscience Services GmbH.

In European regulations degradation rates in soil (DegT50) from terrestrial field dissipation studies (TFD) studies considered for exposure modeling may originate from "any" sites with soil and climatic conditions similar to Europe. An OECD Ecoregion similarity model (ENASGIS) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. The model was to be acceptable. The normalization SFO DegT50 be extended to other regions of the world. An experimental and GIS/modeling feasibility study ("Southside") was initiated to demonstrate if TFD studies conducted in the Southern hemisphere (i.e. New Zealand, Chile) under climatic, soil and cropping conditions similar to conditions in the Northern hemisphere may deliver similar soil degradation rates and DegT50 endpoints than those from Europe. Similar similarity zones were identified between the New Zealand and Chilean sites and EU/NAFTA using the OECD ENASGIS tool as well as an adapted GIS crosswalk with JRC-EFSA climate and soil maps for EU. The trial sites had soil types ranging from loamy sands, sandy loam, loam and silty loams. In New Zealand the sites were located on the Northern Island having an average annual air temperature of ~ 12-13 °C and an average cumulative annual rainfall of ~ 780-970 mm. In Chile the sites were located in the Region del Bio-Bio east of Concepción having an average annual air temperature of ~ 14 °C and an average cumulative annual rainfall of ~ 800-900 mm. The terrestrial field dissipation study (TDF trials) were conducted according to OECD 232 (DegT50 module, soil covered with sand) with different pesticides at 3 sites in New Zealand and in Chile, having no historic use of these pesticides. All pesticides were applied in commercial formulations as a tank mix together in the same spraying on the same field plots at the same time. The field DegT50 were normalised to reference conditions (20°C, moisture pF2) during kinetic analysis according to FOCUS, considering local soil conditions and weather data to estimate soil temperature and soil moisture with the PEARL model (as had been done with the EU studies). The quality indicator values of curve fit to data (Chi-square) were found to be acceptable. The normalized SFO DegT50 in the "Southside" trials in New Zealand were found to be in the range of those from TFD studies in Europe using the same study design.

MO121 Residues of currently used pesticides in Central Europe arable soils: status quo, reasons and consequences

J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX, P. Kosubova, Central Institute for Supervising and Testing in Agriculture; S. Polakova, Central Institute for Supervising and Testing in Agriculture / Official control section; M. Hvezdova, Masaryk University / Research Centre for Toxics Compounds in the Environment (RECETOX); L. Brodký, Charles University in Prague; J. Bledluk, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); P. Dinovská, AQUATEST Inc.; Z. Simék, L. Skulcová, Masaryk University / Research Centre for Toxics Compounds in the Environment (RECETOX); M. Šedoma, Masaryk University / Faculty of Science, Masaryk University / Central Institute for Supervising and Testing in Agriculture; M. Svobodová, L. Krkolovská, J. Vasilikova, Masaryk University / Research Centre for Toxics Compounds in the Environment (RECETOX); N. Neuwingrová, Masaryk University

Current agricultural management is usually based on high consumption of pesticides which may bring a lot of environmental problems. Alarming results from monitoring pesticide residues in EU groundwater and surface water evoke the question of whether the arable soil can contain significant contamination as a result of the intensive use of pesticides in the present or past. Therefore, in 2014 - 2017, agricultural soil was monitored at more than 100 locations in the Czech Republic for more than 50 representatives of currently used pesticides, their selected transformation products and also banned atrazine and simazine with their transformation products. The results showed that the contamination of the monitored soils with the analysed pesticides is quite extensive. At least one pesticide was detected in 99% soils and in 81% soils the concentration of at least one pesticide exceeded the threshold of 0.01 mg/kg. The soils also frequently contained multiple residues: 85% soils contained 3 or more pesticides and 51% soils 5 or more pesticides. Over half the soils (53%) contained at least 2 pesticides exceeding 0.01 mg/kg. The most frequent compounds were triazine herbicides (present in 89% soils), which were also in significant concentrations (47% soils with triazine sum exceeding 0.01 mg/kg). Based on the association with the occurrence of tert-butylazine to atrazine, it was concluded that that banned trioxime simazine is still introduced significantly to the soils as an allowed impurity of massively applied terbutylazine. Persistent atrazine residues are still a legacy of the past, even over 10 years after its last use. The second most frequent compounds were conazole fungicides (present in 74% soils; 53% soils with conazole sum exceeding 0.01 mg/kg). Although no health or environmental risk analysis has yet been carried out on the data, the results draw attention to potential impacts, because: (a) foreign limits based on risk calculations have often been exceeded; (b) many of these substances are suspected carcinogens or endocrine disruptors; (c) substances occur in mixtures whose (eco)toxicity may be additive or even synergistic. The research was carried out with the support of the GACR (project 15-20065S).

MO122 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer?

P.I. Adrianova, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR

Current pesticide regulatory ecological exposure assessments conducted by the U.S. Environmental Protection Agency are almost exclusively based on standard scenario computer modeling. Monitoring data may exist from targeted (prospective or retrospective) programs and for general water quality research by industry, governments, and academic organizations. However, use of the monitoring measured data has been limited in the regulatory assessment process to refine/inform modeling. The limited use of water monitoring data is largely due to variability in the monitoring program sampling designs (frequencies, timing etc.) and insufficient information regarding the exposure conditions and the context sensitivity of the vulnerability of the monitoring locations to broader regional extent. In this paper, we summarize a set of recently developed approaches to infer and quantify realistic pesticide exposure potential based on monitoring data, including bias factor (BF), universal kriging (UK), and survey statistics. These approaches can be used in a systematic way to provide a useful reality check for comparison with exposure model output in regulatory assessments, thus increasing confidence in decision making. Examples of applying these approaches are provided to demonstrate their usefulness for watershed scale assessments.

MO123 Recent development of approaches for quantitative use of surface water monitoring data in aquatic exposure assessments

W. Chen, Syngenta Crop Protection, LLC; P. Mosquin, J. Aldworth, RTI International

Current pesticide regulatory ecological exposure assessments conducted by the U.S. Environmental Protection Agency are almost exclusively based on standard scenario computer modeling. Monitoring data may exist from targeted (prospective or retrospective) programs and for general water quality research by industry, governments, and academic organizations. However, use of the monitoring measured data has been limited in the regulatory assessment process to refine/inform modeling. The limited use of water monitoring data is largely due to variability in the monitoring program sampling designs (frequencies, timing etc.) and insufficient information regarding the exposure conditions and the context sensitivity of the vulnerability of the monitoring locations to broader regional extent. In this paper, we summarize a set of recently developed approaches to infer and quantify realistic pesticide exposure potential based on monitoring data, including bias factor (BF), universal kriging (UK), and survey statistics. These approaches can be used in a systematic way to provide a useful reality check for comparison with exposure model output in regulatory assessments, thus increasing confidence in decision making. Examples of applying these approaches are provided to demonstrate their usefulness for watershed scale assessments.

MO124
Multi-year evaluations in the FOCUS Surface Water assessment - results of beta testing
D. Weber, M. Brauer, Eurofins Regulatory AG / Environmental and Ecological Modelling; A. Bolekhun, Bayer AG, Research & Development, Crop Science; G. Spickermann, ADAMA Deutschland GmbH; D. Schaefer, Bayer Crop Science / Environmental Safety

The calculations of the predicted environmental concentrations (PEC) of active substances in surface water are based on a “single year” approach with an initial 6 year warm-up phase followed by 16 months of the year selected by the FOCUS group. Unlike in groundwater with a 20 years assessment period, surface water exposure calculations based on a “single year” approach can be strongly affected by individual rainfall events (EFSA, 2013) which was discussed repeatedly by authorities, industry and academia (Klein, 2013, Goerlitz, 2015; Bach et al., 2016, Poulsen, 2016). This presentation provides background on the technical methods and assumptions currently implemented into a software tool (Weber et al., 2017) that allows 20-year simulations of FOCUS surface water scenarios. In addition, results of a beta test including revealed technical issues, problems and assumptions are discussed. The software tool in its current state can easily be adapted to updated technical requirements or changes, i.e. any comments from official side (EFSAs FOCUS Repair Group) or from other sources can be addressed according to given consensus. The aim is to contribute to the development of an improved and generally accepted approach for surface water calculations representing a realistic worst case based on a robust evaluation. Bach M et al. (2016): Pesticide exposure assessment for surface waters in the EU. Part 1: Some comments on the current protection. Pevl. Nature Sci. 2015: 172; 174–184. UK companies: Multiar FOCUS surface water modelling: Options and Proposals for Realisation. XV: Symposium in Pesticide Chemistry. Piacenza, Italy. September 2015 Klein M (2015): Long term surface water simulations using the FOCUS scenarios. Pesticide Behaviour in soils, Water, and Air, York, UK. September 2013 Poulson V (2016): Higher tier assessments of aquatic and terrestrial studies. AGCHEM Forum, Barcelona, Spain. September 2016 Weber et al. 2017: Multi-Year evaluations in the FOCUS Surface Water assessment. Conference Pesticide Behaviour in Soils, Water and Air, York 2017.

MO125 Spatial and temporal explicit catchment modelling in aquatic risk assessment using the modular framework CMF
S. Multsch, F. Krebs, S. Reichenberger, DR. KNOELL CONSULT GmbH; S. Heine, Bayer Ag / Effect modelling; P. Kraft, L. Breuer, Justus Liebig University Giessen / Chair of Landscape, Water and Biogeochemical Cycles; T. Schad, Bayer Ag / Environmental Modelling

The FOCUS Agent-Based Guideline Document on Aquatic Risk Assessment indicates a key role for effect modelling in future aquatic risk characterisation in a tiered risk assessment framework. Such approaches require correspondingly adapted exposure tools and scenarios ranging from simple edge-of-field to spatiotemporally explicit landscape-scale catchment models. These approaches should be sufficiently flexible and transparent in order to design lower- and higher-tiers of consistent protection. Pevl. Nature Sci. 2015: 172; 174–184. CMF comes with a hierarchical model structure which makes adaption to tiers of different complexity difficult. Flexible and modular approaches are needed to provide a spatially and temporally explicit aquatic exposure pattern to investigate effects on organisms according to Specific Protection Goals. A flexible and modular catchment model for water and pesticide transport has been developed which allows for stepwise adaption of model configuration. The GLUE approach of parameter uncertainty assessment is based on the hydrological programming library CMF. Core functions of CMF are implemented in C++ and specific catchment setups are designed by Python scripting. The current approach focuses on the following abilities in order to investigate landscape-scale interactions: (a) a modular programming structure that enables replacement of process descriptions and (b) an incorporation of additional modules; (c) an up-to-date connection between models as memory level in order to ensure high computing performance. A landscape is represented by the following components: Vertical water fluxes in fields are modelled with Richards equation, with the soil profile discretised into 24 Soil layers. Each field holds a surface water, a groundwater and an optional drainage storage which are connected by a kinematic wave model. The water growth (phenology, leaf and root growth, water uptake) is modelled with similar methods and parameters as in the model MACRO. The setup was tested for a 350 ha catchment in Belgium under intensive arable use with detailed information on farming practice and observed discharge as well as herbicide loads at the catchment outlet for a time period of almost four years. The predicted environmental concentrations were used as input for an effect model in order to investigate the impact of the herbicide loads on the aquatic plant Lemna at population level.

MO126 Determination of runoff and drainage triggers for PEC surface water using automated simulation with FOCUS models
B. Kind, A. Guckland, J. Kleinmann, WS Sciencef Scientific GmbH

For the zonal registration in the EU predicted environmental concentrations in surface water need to be simulated based on the FOCUS models. Three different entry paths are considered: runoff (simulated in PRZM), drainage (MACRO) and spray drift (SWASH drift calculator). While the latter only depends on the amount sprayed, the distance to the water body and the spray equipment used, runoff and drainage amounts are also triggered by substance properties, e.g. degradation in soil and adsorption to soil. Often, a lot of runs need to be simulated for different crops or application timings to proof a safe use of plant protection products as defined in the Good Agricultural Practice (GAP). For this poster we evaluate the FOCUS scenarios compared to the substance properties DT50 and KOC. The idea is to find DT50 and KOC values which trigger runoff and drainage addition and to distinguish worst-case FOCUS scenarios for different DT50 and KOC values. Dummy substances will be created which have different values for KOC and/or DT50 in soil. The remaining properties will be identical for each KOC/DT50 variation. Using automated FOCUS surface water simulations PECsw values were calculated for different scenarios at different application times within the whole year. We used as entry paths to focus solely on drainage and runoff. The results for different KOC/DT50 values of a single scenario were compared to identify a trigger value for runoff or drainage in this scenario. Furthermore, the results of different scenarios for a single substance will be compared to find the most sensitive scenario for these KOC/DT50 values. Finally, the amount of simulations necessary to show a safe use might be reduced to certain worst-case scenarios depending on the DT50 and KOC properties of the substance.

MO127 Quantitative exploitation of passive sampler data for pesticide mass flow calculation in catchments and exposure risk evaluation
T. Gasperi, Luxembourg Institute of Science and Technology; M. Bayerle, D. Pittius, V. Huck, Luxembourg Institute of Science and Technology LIST

Pesticide monitoring remains the blind spot in WFD monitoring schemes because of the episodic occurrence of their emissions following application periods. Full coverage of relevant exposure periods is logistically impossible on a larger scale with classical monitoring methods like grab or automatic sampling. Passive sampling devices allow for a cost-effective long-term monitoring that is independent of weather conditions and allows thereby a good spatial resolution. However, passive sampling still suffers from a lack of confidence of regulators and investigators with regard to the reliability of the ambient concentrations it represents and the supposed variability of sampling rates in the field. This contribution will show a rational monitoring strategy that has been applied in several catchments in Luxembourg and validated with parallel autosampling of flood events during application periods. It establishes that passive sampling is essentially time proportional and that base- and high flows can be separated for their contribution in terms of time-weighted averages and event mean concentrations. The biases and uncertainties in terms of load calculations are addressed. Based on monitoring in different hydrogeological contexts the approach is used to derive land and crop specific loads in catchments and exceedence probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.

MO128 Spatially distributed environmental fate modelling of terbuthylazine in a mesoscale agricultural catchment using passive sampler data
M. Gassmann, University of Kassel / Department Water Quality Management - Modelling and Simulation; T. Galle, Luxembourg Institute of Science and Technology; J. Farlin, Luxembourg Institute of Science and Technology LIST

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The impact of agricultural practices on water pollution can be addressed. Based on monitoring in different hydrogeological contexts the approach is used to derive land and crop specific loads in catchments and exceedence probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.

MO129 Spatially distributed environmental fate modelling of terbuthylazine in a mesoscale agricultural catchment using passive sampler data
M. Gassmann, University of Kassel / Department Water Quality Management - Modelling and Simulation; T. Galle, Luxembourg Institute of Science and Technology; J. Farlin, Luxembourg Institute of Science and Technology LIST

The impact of agricultural practices on water pollution can be addressed. Based on monitoring in different hydrogeological contexts the approach is used to derive land and crop specific loads in catchments and exceedence probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.
Pesticide losses via drainflow are strongly dependent on the soil moisture status at the time of application and the rainfall pattern that follows application. For drainflow simulations, the choice of application date can therefore have a significant influence on predicted environmental concentrations. To standardise the selection of application dates, the FOCUS surface water models include a calculator tool, the Pesticide Application Timer (FOCUS PAT), which selects an application date within a window defined by the user by applying a set of rules to the daily rainfall data used in the simulation. Alternative criteria for selecting application dates for drainflow simulations were proposed by Brown et al. (2004; Pest Manag Sci. 2004 Aug; 60(8): 765-76), and incorporated into a modelling tool developed recently by the HSE’s Chemicals Regulation Division (CRD) for performing UK higher tier drainflow assessments using the MACRO model. Under these rules (referred to herein as CRD PAT) a different set of criteria is applied to the daily rainfall data, with the algorithm selecting the first compliant date on or after a particular target day. Both the FOCUS PAT and CRD PAT algorithms select pesticide application dates based on daily rainfall volumes. In practice, however, application dates can be constrained significantly by the trafficability of the soil. Product GAPs are designed to cover a wide range of application periods to account for seasonal variation, e.g. in dry springs applications might take place in March while in wetter years, when it is more difficult to traffic wet soils, they may take place in April or even early May. When conducting multi-year modelling risk assessments this nuance is often lost from the risk assessment, and applications are forced into months when farmers would not have been able to travel their lands and apply crop protection products. Using a soil moisture deficit based approach to traffic the surface water compartment of the model, in addition to trafficability, other factors such as the risk of pesticide residues emitted to surface water bodies are from urban and agricultural sources. At present these sources are risk assessed using very different scenario-based approaches in isolation. Using a multi-disciplinary approach drawing on landscape implementations of the FOCUSssw scenarios to describe possible agricultural and urban erosion models to describe possible hard surface usage, this poster considers the likely pesticide residues emitted under these different sources of pesticide residues. The need for these two sources to be considered jointly within landscape and catchment scale risk assessments and the possible implications are discussed.

MO133
Calibration of passive samplers for the monitoring of chlordecone in French Caribbean rivers
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The uncertainty of the tropical weather in the French Caribbean makes spot sampling of chlordecone obsolete and new approaches should be explored to monitor the fate of this molecule. Three passive sampler designs have been evaluated: two integrated samplers, differing by their membrane, were calibrated in laboratory and on field for 14 days for the molecule chlordecone: the classical POCIS (Poly Organic Chemical Integrative Sampler) (with Polysulfone membranes), the POCISny 30µm (with nylon membranes), and the POCISny 0.1µm. Calculated sampling rates (Rs) were corrected by a PRC ( Performance Reference Coefficient) approach. This study shows that, even under a continuous flow system, and the field calibration was done in triplicates in river Cap estere (Guadeloupe, French Caribbean). Rs in laboratory calibration were 0.30±0.02 L.day⁻¹ for the POCIS, 0.07±0.01 L.day⁻¹ for the POCISny 0.1µm and 1.54±1.38 L.day⁻¹ for the POCISny 30µm. Two distinct Rs have been calculated for the POCIS and the POCISny 0.1µm: one for the first five days of the experiment (Rₛ= 0.19±0.01 L.day⁻¹ for POCIS; Rₛ= 0.48±0.50 L.day⁻¹ for POCISny 0.1 µm) and one for the overall experiment (Rₛ= 0.19±0.02 L.day⁻¹ for POCIS; Rₛ= 0.43±0.01 L.day⁻¹). POCISny 30µm followed the same pattern than in the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than
MO134 Temporal patterns of pesticide residues in four major river basins in Korea
C. Kim, K. Son, Y. Ihm, H. Lee, National Institute of Agricultural Sciences / Department of Agro-food Safety & Crop Protection
To evaluate residues of environmental concerned pesticides which mainly include pesticides used for rice cultivation, total ninety four sampling sites were selected through main streams and branch streams of four major river basins. And the water samples were collected 18 times from April, 2012 to July-August, and September-October or November-December in 2012 and 2014. Besides, the water samples at sites of Keum, Mangyong and Dongjin rivers belong to the Keum river basin were regularly collected with a month interval, especially biweekly from May to August in 2013. Of the pesticides monitored, fenoxanil, hexaconazole, isoprothiolane, iprobenfos and thifluazamide as fungicides were mainly detected in rice season. While other fungicides including diclofop-methyl, fenpiclonil, fenbuconazole, fenpropimorph, metrafenpyr, oxadiazon, simetryn and thiothion were detected with frequencies of 1-48% and in their residue level of 0.01-1.9 μg/L. Detection frequencies and residue levels of insecticides and herbicides were the highest in waters sampled in May and June. Almost pesticides detected were for the rice plants and their residue levels were very low to compare with standard values.

MO135 Occurrence of 14 representative pesticides in surface and ground waters of the State of São Paulo, the biggest sugarcane producer in Brazil
R.D. Acayaba, SCHOOL OF TECHNOLOGY UNICAMP; C. Raimundo, UNICAMP / Institute of Chemistry; A. de Albuquerque, G. Umbuzeiro, School of Technology, UNICAMP / LAEG São Paulo State is the biggest sugarcane producer in Brazil and the second at pesticide consumption. The aim of this project was to develop a method to determine the presence of 14 pesticides representative from sugarcane plantation, 7 herbicides (simazine, atrazine, ametryn, clomazone, diuron, hexazinone and tebuthiuron), 3 fungicides (azoxystrobin, carbademazin and tebuconazole), 3 insecticides (carbofuran, imidacloprid and malathion) and 1 transformation product (atrazine-2-hydroxy) in surface and ground waters using liquid chromatography tandem-mass spectrometry (LC/ESI/MS/MS) and solid phase extraction as sample preparation. Limits of detection (LOD) and quantification (LOQ) were ranged from 0.9 to 0.0009 ng/L and from 2.8 to 74 ng/L, respectively, which meant recovery was 66%, which allowed obtaining a sensitive and accurate method for the determination at trace levels. In total, 196 samples located in the main sugarcane area from São Paulo were analyzed (175 surface waters and 21 groundwaters) between October/2015 to October/2016. The most frequently detected pesticides in surface water were atrazine-2-hydroxy (100%), diuron (94%), carbademazin (93%), tebuconazole (91%), imidacloprid (91%), malathion (81%) and fenoxanil (81%). The pesticide that presented the highest concentration for this matrix was imidacloprid, reaching 2579 ng/L. The risk to aquatic life were evaluated dividing the maximum environmental concentration of each pesticide by the lowest water quality criteria found in the literature. The potential risk for aquatic life was observed for imidacloprid, carbademazin, atrazine and malathion. For the groundwaters the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidacloprid (14%), carbademazin (10%), tebuconazole (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebuconazole, reaching 107 ng/L.

MO136 Exposure scenarios for aquatic risk assessment of pesticides in Brazil
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A tri-party technical working group consisting of regulators, academia and industry was formed to develop a framework for aquatic risk assessment of pesticides in Brazil. The framework should include a sophisticated science based approach resulting in a comprehensive guidance. The basis of the exposure assessment is the selection of the 90th percentile vulnerability which is seen to represent a reasonable worst case and is used as basis of the exposure assessment in other parts of the world. Surface water scenarios should be identified in six pre-defined climatic zones for the seven most important crops soybean, maize, sugar cane, wheat, cotton, citrus and coffee. Runoff and spray drift were found to be the main entrance pathways of pesticides into surface water bodies. Whereas spray drift mainly depends on technology and local climatic conditions during application, surface runoff is influenced by pedoclimatic conditions that could be assessed in a spatial vulnerability analysis. For this the USDA Runoff Curve Number approach (RCN) which is implemented in PRZM was used. A simple model based on the equations of the RCN approach was developed to calculate daily surface water runoff volumes for the agricultural area of Brazil for 34 climatic years. Calculations were carried out on highest available resolution of soil data resulting in more than 63,000 raster cells. Hydrological soil groups were determined by using a Brazilian specific classification scheme applied to the national soil map. Relative runoff vulnerability for pesticides was estimated with an integrated vulnerability index approach where indices for daily runoff such as average annual number of runoff events and average maximum runoff volume of each year were combined with an index for the expected substance concentration in the runoff water based on organic carbon content of the soil. The 90th percentile relative vulnerability was determined for the relevant crops for each climatic zone to select the relevant surface water scenarios. For the specific crop area, census data on municipality level were used first, but it was decided to switch to satellite images as far as they become available. After discussions in the technical working group the Brazilian environmental authority IBAMA decided to use the US-EPA PWC model for the surface water exposure assessment. Representative flowing and static water bodies which need to be natural and permanent will be defined for each selected scenario.

MO137 Identification of Herbicide Source Areas and Spatial Variability of Dominating Transport Processes in a High Agricultural Intensity Catchment H. Rathgens, M.F. Winchell, Stone Environmental, Inc. / Environmental Systems Modeling; S. Sur, Bayer AG Crop Science Division; E. Sur, Bayer AG Crop Science Division; D. Baets, Bayer AG Crop Science Division / Sustainable Operations; F. Krebs, DR. KNOELL CONSULT GmbH; D. Lembrich, Bayer AG Crop Science Division
The occurrence of herbicides in surface waters of intensively cultivated catchments can originate from a variety of sources. These include transport via runoff and erosion during storm events, subsurface transport through lateral flow and through subsurface tile drainages, and from spray drift during applications. The Soil and Water Assessment Tool (SWAT) is widely used in the United States and the EU for catchment scale hydrologic and water quality modeling of non-point source chemicals in the environment. The SWAT model was applied to a 992 ha agricultural catchment in the Flanders region of Belgium to help in better understanding the dominant transport processes contributing to pesticides residues to the stream. While surface runoff of soluble pesticide was the major non-point source contributor on most fields, lateral subsurface flow was found to be important as well, especially in the western portion of the catchment. Spray drift is likely the least significant contributor at the catchment scale. Overall, the analysis of monitoring data and modeling results shows that the potential for reducing herbicide concentrations in the study catchment can be addressed by mitigating both point source contributions from farmyards as well as diffuse sources.

MO138 Pesticides in water and surface sediments from Douro River estuary (Portugal) - assessment of environmentally relevant mixtures using acute toxicity bioassays
M. Melo Rocha, ICIRAS U.Porto, CICMAR CIMAR LA; C. Cruziero, CIMAR CIMAR LA; Porto, CEF; CTUC U.Coimbra; S. Amaral, ICIRAS U.Porto; E. Rocha, ICIRAS U.Porto, CICMAR CIMAR LA
The Douro River is an international water river that passes through extensive agricultural fields, of both Portugal and Spain, before reaching the estuaries at Porto and Gaia cities. Therefore, the presence of pesticides is suspected. Accordingly, the evaluation of 56 pesticides of different categories (insecticides, herbicides, and fungicides) should be viewed as a priority for this habitat due to their negative impacts on the biota. For this purpose, water was collected over one year at six sampling sites in the Douro River estuary. Samples were extracted by solid-phase
MO139  
Modelling programme to investigate the presence of myclobutanil and its soil metabolite in Italian groundwater following use in pome fruit, stone fruit and vineyards

G.L. Reeves, Dow AgroSciences Ltd; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l. / Department of Earth and Environmental Sciences; C. Vai, Dow AgroSciences Italia s.r.l.; R. Bradascio, Dow AgroSciences Italia s.r.l.

Identification of areas at risk of groundwater leaching in Italy for the pesticide myclobutanil and its metabolite (X11292885) were below the LOD (1 ng/L) in 99.9% of samples. The method used was gas chromatography-time of flight mass spectrometry (GC-MS). Results show that 96% of measured pesticides were detected in 79% of the quantified samples and that twelve compounds showed concentrations well above the limits established by the 2013/39/EU Directive. Individually, the concentrations of the analysed pesticides ranged from 39 to 1265 ng/L. Since the occurrence of these compounds happens in mixtures, we conducted a theoretical hazard assessment considering the average and the maximum environmental mixtures of all monitored pesticides. The theoretical approach suggested that invertibratea were the most sensitive group. Therefore, short-time exposure in vivo assays using Artemia salina and Daphnia magna were done. These results disclosed significant toxic effects of the analysed mixtures - high mortality rate and abnormal swimming behaviour - over the exposed animals. Both approaches (theoretical and experimental) confirmed the biological results in order to identify the target areas on this estuarine environment and of other comparable. 

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Keywords: monitoring, Artemia salina, Daphnia magna, pesticide mixtures

MO140  
Development of an European Tier 3+ Spatially Distributed Modelling Framework

G. Hoogeweg, Waterborne Environmental, Inc. / Data Technologies; P. Sweeney, Syngenta

Higher tier groundwater assessment in the European Union (EU28) allow the use of spatially distributed modeling approaches for the assessment of groundwater and exposure of soil organisms. In a distributed modeling approach, regional data inputs can reflect local conditions and capture the spatial variability of the landscape and weather patterns. An advanced modelling framework, based on the GeoPEARL 4R model was developed for the EU28. This model fills the niche for higher Tier assessments needs. This modelling framework represents over 1.340,000 km² of arable agricultural lands in Europe. Nearly 382,000 Unknown soil data, weather, FOCUS zone combinations represent the variability of the landscape and climate. Datasets to populate the model, included CORINE land cover, soils data (EDSB, ESDB Derived Data for Modelling and HYPRE, EFSA organic matter) and the JRC MARS 25km gridded daily weather data. Agricultural management practices, irrigation, and cropping scenarios are gleaned from the standard FOCUS model. This tier 3+ model, but can be updated as needed. A distributed modeling framework (EMF2014) can be used for EU28, member state, FOCUS zones or crop specific groundwater vulnerability assessments, screening of existing and new plant protection products, context setting of standard scenarios, test sites, and lysimeter, site selection. In this presentation we will show how we developed the framework and several example outputs as well as discuss the implications of conducting large-scale distributed modelling assessment.

MO141  
Influence of aquifer parameters on groundwater residence concentrations

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Modelling leach models are used in a regulatory context to calculate pesticide leaching flux concentrations in 1 m depth (PECFM; “Predicted Environmental Concentrations in groundwater”) from the unsaturated to the saturated zone. These values are used in risk assessments to evaluate the impact of plant protection products on groundwater. In higher tier groundwater monitoring studies the properties of the saturated zone add additional complexity influencing actual pesticide residue concentrations in shallow groundwater. In this work the impact of groundwater flow velocity and aquifer porosity on groundwater residues for a defined leachate concentration (i.e. decoupled from the unsaturated zone) was determined. In a sensitivity analysis a range of aquifer parameters the impact on the resulting residue concentrations in groundwater was quantified. For the sensitivity analysis FOCUS model outputs for selected scenarios were combined with realistic aquifer parameters for some representative regions in northern Italy and Germany. In these regions the relevant shallow aquifers are variable in terms of hydraulic conductivity, gradient and effective porosity and provide a representative parameter range.

MO143  
Implications of Dataset Selection and GIS Processing on Modelling

G. Hoogeweg, Waterborne Environmental, Inc. / Data Technologies; M. Geuvara, Waterborne Environmental Inc / Modeling

Groundwater assessment guidelines provided by the FOCUS groundwater working group (2009) and EFSA (2014) describe succinctly a multi-tiered modelling framework that includes spatio-temporal assessments in the higher tiers; e.g., tier 3a and 3b. As part of the spatio-temporal assessment several GIS and daily climate
datasets were recommended. These recommended datasets, however, have been superseded by new datasets in the past few years. Specifically, daily weather and soils data have undergone significant updates, which are reflective of the considerable effort in Europe to update this spatial information. Not only does dataset choice, but also how datasets are being processed in a geographic information system, impact modeling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data resolution influence our modelling results. In this paper, we will show the implications of data selection and data processing on a distributed modelling framework centered around GeoPEARL 4R. Specifically we will focus on differences between datasets, data set resolution, capturing variability and ones ability to model at the pan-European level within EFSA’s tier 3 guidelines.

MO144 Combining specific and public groundwater monitoring data as higher tier for pesticide regulatory risk assessment
A. Boivin, ANSES

Pesticides risk assessment for groundwater in France is performed according to Regulation 1107/2009. The European tools are routinely used by considering the same models and same tiered approach. Groundwater monitoring data are identified as higher tier that may supersede modelling. Still, there is currently no agreed guidance available on the use of groundwater monitoring data for regulatory purposes. Work is ongoing on behalf the SETAC-EMAG GW group (www.setac.org/group/SEAGPGest). The main issues when dealing with groundwater monitoring program are related to site selections and related vulnerability, and then of how representative was the groundwater monitoring. In recent case, usefulness of the groundwater monitoring programs submitted at EU level as been questioned. Notably, the groundwater hydrology including its vulnerability and how representative / which situations the test sites might be considered to cover were not seen as not being properly addressed. Monitoring programs have also been submitted and assessed at national level mainly to refine metabolite groundwater risk assessment. Combined information from targeted and public monitoring were keys to address the representativeness of monitoring programs. The French groundwater public network (wells) is vast and the database is available online (www.ades.eaudefrance.fr). This database (ADES) is owned by the BRGM (French Geological Survey). This database mainly active substances, more metabolites will be included in the future Proposals to combine targeted together with public groundwater monitoring dataset were made to enhance the representativeness of the GW monitoring conducted.

MO145 Minimal variation in input parameters highly influences PEARL and PELMO results: how can these results be trustable?
S. Ulucci, ICPS; L. Menaballi, International Centre for Pesticides and Health Risk Prevention

The calculation of Predicted Environmental Concentration of pesticides in groundwater (PECgw) is a crucial point in the risk assessment and authorization process of plant protection products (PPPs) in Europe. Calculations are usually performed by FOCUS models, in particular PEARL and PELMO models. These models allow a realistic but conservative assessment of the potential leaching of pesticides in the groundwater compartment. Model results are influenced by substance specific parameters such as DT50, KOM and Freundlich coefficient (1/n). Great variations in PECgw values are expected when high variability occurs in one or more of the parameters listed above. In this work, we demonstrate that PECgw outputs are significantly affected also by minimal variation of the same parameters. Considering that a minimal variation is intrinsic in all laboratory studies (es. 25% uncertainty in KOM determination was calculated applying the Horwitz equation), it is questionable whether a corresponding high variation in model is scientifically acceptable. Model results are normally distributed. The arithmetic mean of all single values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slightly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3-sigma range of the experimental data set. This experimental evidence does not support the proposal to increase the existing default wash-off factor from 0.5 cm-1 to 1 cm-1.


MO146 European regulatory network on pesticide groundwater monitoring
A. Gilgans, The Danish Environmental Protection Agency / Pesticides and Gentechnology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, Cgb; A. Schwenn, AGES; M.E. Balmer, Plant Protection Chemistry; A. Massey, Chemicals Regulation Directorate; W. Tüting, German Federal Office of Consumer Protection and Food Safety

Groundwater monitoring data should be included in the assessment of the leaching risk of pesticides and their metabolites. Monitoring data is generated in most European countries, but their use for leaching risk assessment during pesticide authorization is hampered due to the following reasons: (i) The data is often not publicly available or available only in an aggregated form in a report, (ii) most monitoring data is collected in the national language of the origin country only, which makes it hard for other countries to assess the data, and (iii) in the interpretation of the data, monitoring requires detailed knowledge of the local geological, hydrological and climatic conditions, and also knowledge about crops and the use pattern for pesticides. To overcome these difficulties, a network among regulatory authorities in Europe involved in groundwater risk assessment of pesticides is proposed. The aim of the network is to exchange pesticide groundwater monitoring data and frequent updates about the focus of national monitoring, and to assist each other in the interpretation of the data. The network plans to have its first meeting in Copenhagen, Denmark, in September 2018 with an invitation to all interested European countries to participate. The poster will present the thoughts about the network and the status of the start-up, and aims at promoting the network to interested authorities.

MO147 Overview of measured wash-off factors from experiments suitable to derive a refined input for FOCUS modelling
G. Reinken, E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety; D. Sussfeld, Bayer Crop Science / Environmental Safety

Recent regulatory interest in the wash-off process resulted in a proposal to that the effects of wash-off should be generally considered as additional soil loading for FOCUS modelling of foliar applied pesticides (EFSA 2010, 2016). EFSA also proposed to increase the default wash-off factor for FOCUS modelling from 0.5 cm-1 to 1 cm-1 (EFSA 2012). On the other side, EFSA has stated that effects of wash-off should not be considered as an additional worst case but rather as average effect (EFSA 2015, 2017). The foliar wash-off factor of a compound is a product (formulation) specific modelling input parameter that can be experimentally determined. A generic experimental study design has been derived in a workshop organised by the European Crop Protection Association (ECPA). This study design was used for the experimental determination of wash-off factors for modelling purposes. Overall 25 individual wash-off factors have been determined experimentally, mainly under GLP. The data set comprises 12 formulations, 8 compounds and 6 crops. Experiments consider one heavy rainfall event of 15 mm over one hour, applied 24 hrs after foliar pesticide spray. The determined wash-off factors are normally distributed. The arithmetic mean of all single values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slightly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3-sigma range of the experimental data set. This experimental evidence does not support the proposal to increase the existing default wash-off factor from 0.5 cm-1 to 1 cm-1.


MO148 Leaching and plant uptake of trifluoroacetic acid (TFA) under cropped outdoor conditions
G. Reinken, M. Beckmann, Bayer AG, Research & Development, Crop Science / Environmental Safety; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; U. Kölzer, Bayer AG, Research & Development, Crop Science / Environmental Safety; M. Lamshoef, Bayer CropScience AG / R&D; S. Sittig, DR. KNOELL CONSULT GmbH / E-Fate Modelling

In recent regulatory discussions about the plant uptake process the question was raised if tracer-like substances (very low or zero sorption, very slow or no degradation) are fully available for uptake by plant roots under dynamic outdoor conditions. In an alternative hypothesis is that such substances move so quickly in the soil column that they are taken up by plant roots to a lower extent than indicated by static laboratory plant uptake studies. To address this particular question an outdoor container study was conducted with 14C-labeled trifluoroacetic acid (TFA) and winter wheat plants for a time period of 228 days after application onto soil. Trifluoroacetic acid is a common breakdown product of several chemical product classes (e.g. refrigerants like HFCs and HCFCs, anaesthetics, pharmaceuticals, pesticides, pyrolysis of PTFE (used as coating in may products like Teflon® or GORE-TEX®)). Plant root uptake of TFA under static conditions has been determined in parallel with experiments using plants growing in nutrient solution (hydronic study design). The translocation and uptake of trifluoroacetic acid observed in the outdoor container study was evaluated with the FOCUS model considering root uptake processes as routinely applied in standard FOCUS modelling. A transpiration stream concentration factor (TSCF) for TFA under cereal growing outdoor conditions could be derived. The results demonstrate that mobile, tracer-like substances are taken up extensively by plant roots even
under dynamic outdoor conditions; the hydroponic study design is suitable to determine conservative input parameters for regulatory modelling; uptake experiments with cropped outdoor container may be suitable as higher-tier to derive a refined TSCF. Further experiments will indicate to which extent this study design is also suitable to derive refined TSCF for compounds with other sorption and degradation properties.

MO149 Investigating the variance of edge-of-field deposits of spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Michielsen, H. Stallinga, P. Van Velde, J. Van de Zande, Wageningen University and Research / Agrosystems Research

Spray applications in arable crops often lead to off-target spray deposits downwind from the treated field. Throughout several decades, many experiments have been carried out by different researchers to quantify the downwind spray deposits. Relationships between downwind spray deposits and parameters like sprayer settings, field conditions and environmental conditions were investigated. Still, there is a large variance in the observed data that cannot be explained satisfactorily by the experimental and environmental conditions. Spray boom movements and local fluctuations in driving speed, wind speed and wind direction are the most likely factors affecting variance in downwind spray deposits. In this study variations in downwind deposits of spray drift caused by sprayer boom movements are investigated both experimentally and based on simulations using the spray drift model IDEFICS. Downwind deposits of spray drift were measured alongside a treated potato field, at 2 m and 5 m off the edge. A quasi-dynamic model was developed based on the IDEFICS spray drift model. In the new model the effect of both horizontal and vertical boom movements on downwind spray deposits was studied. From the above mentioned experiments, the most important frequencies and amplitudes of boom movements were derived. Using these frequencies, the model simulations resulted in variances of spray drift deposits similar to those established experimentally. Effects of fluctuating wind directions are to be investigated in the near future.

MO150 Exposure assessment for edge-of-field watercourses next to tree nurseries regarding spray drift deposits
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

Pesticides and agrochemicals applied to field crops involve spraying techniques that apply the pesticide in upward or sideways direction. Particularly for high avenue trees the downwind loss of pesticides due to spray drift can be relatively large. The upward directed part of the spray that is blown towards the top of the trees may reach heights above the trees, where wind can take the spray cloud and move it far downwind. Usually, the branches and leaves at the lower part of the stems of high avenue trees may pass underneath the tree canopies and reach downwind areas easily. Measurements of downwind spray deposits for tree nurseries indicate deposition levels comparable to those occurring for fruit orchards, which are well above those occurring when spraying arable crops. The current paper deals with the countrywide exposure assessment for pesticides applied to tree nurseries reaching edge-of-field watercourses in the Netherlands. Experiments with high avenue trees, nurseries with the younger spindles and transplanted trees are considered as well. Although the total area of tree nurseries is limited, exposure risk to edge-of-field watercourses is important enough to investigate. Spray drift mitigation techniques are considered and evaluated as well.

MO151 Investigating the exposure of residents to pesticides due to airborne spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, J. Michielsen, H. Stallinga, P. Van Velde, Wageningen University and Research / Agrosystems Research

In the Netherlands more than 90,000 people live within 50 m of flower bulb or fruit cultivation. It is unclear how many of these people are exposed to pesticides or whether their health is at risk. Recently, a research project was launched to assess the exposure of residents to pesticides next to flower bulb fields. This research project involves both measurements and simulations of airborne spray drift. Volatilization is investigated for several days after spray application. Outdoor and indoor exposure to airborne pesticides in the near field is assessed in the near future. Inhalation exposure is estimated in the near field with the exposures to spray drift only. After application using a conventional boom sprayer ground deposits and airborne distributions of spray drift are measured down to 50 m from the treated area. Airborne spray drift is measured up to 10 m height, using two different sampling techniques. At 50 m downwind, airborne spray drift appears to be up to 100 times higher than ground deposits. Simulations of spray drift are studied using the IDEFICS spray drift model for boom sprayers. The simulations result in downwind ground deposits and airborne spray drift with values in the same order of magnitude as those found in the experiments. The results indicate that potential exposure of residents to pesticides used when treating nearby fields may be significant and further assessment of this exposure route is important.

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This paper does not provide guidance on how to conduct a risk assessment for consumers of co-formulants present in plant protection products. One of the reasons is the lack of exposure data when the product containing its co-formulants is applied onto crops. To our knowledge only one software is predicting the level of crop residues of chemicals after application i.e. PARDIS [1] (Prediction of Agricultural Residue Data). In the near future, the use is limited to orchards. In addition, in the case of polymers, from an analytical point of view it may be difficult if not impossible to analyse the crops for residue content of this type of co-formulant. The objective of this work is to develop a methodology to be applied under these conditions. As a case study we present this methodology for latex polymers i.e. polymer based on methylene succinic acid with buta-1,3-diene, styrene and methacrylic acid. [1] Prediction of agrochemical residue data on fruit using an informatics system (PARDIS model), Calliera M, Balderacchi M, Capri E, Trevisan M. 2008

MO153 Dietary exposure to pesticide residues; the big picture
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Science-based approaches and integrated risk assessment by using experimental data, models for pesticide residues intake estimations, monitoring data considering real exposure, etc. are working tools to contribute to the mission of the European Food Safety Authority (EFSA) on protecting European consumers’ health and the environment in the field of pesticide residues. Maximum residue levels (MRLs) are assessed for the upper levels of pesticide residues that are legally permissible in food of plant and animal origin. Before an MRL is established, the EFSA assesses the residue behavior of the pesticide and the dietary exposure resulting from the residues expected in food. The chronic and acute dietary consumer exposure to pesticide residues are estimated by using a calculation model developed by EFSA called PRIMO (Pesticide Residue Intake Model) based on the integrated agreed methodology. This provides the key information to be interpreted by risk assessors and for risk managers’ consideration. Essential input values in risk assessment are toxicological data and residue values subject to many environmental scenarios and considerations that are used to define and characterize the residues to which consumers are exposed through the diet. Complex metabolic pathways in plants and animals, degradation of the compounds in soils and in its transformation, the possible uptake and translocations of the residue to the edible parts of the crop and degraded products as result of industrial and household processing are considered to set the residue definitions for risk assessment purposes. Secondary metabolites characterized by metabolism studies and degraded products may pose a completely different toxicological profile than the parent compound, being more, less or equal toxic than the pesticide under assessment, and showing a new big picture for an active substance and its residues that should be assessed in detail to avoid consumers’ concerns. The dietary risk assessment of pesticide residues takes into consideration these possible scenarios in order to protect consumers, reason why residue definitions might be different for monitoring and for risk assessment purposes and where the uncertainty due to missing data might play a fundamental role in risk assessment.

MO154 Exposure and Risk Assessment for Agricultural Applicator to Insecticide Flubendiamide during Cabbage Cultivation using Whole Body Dosimetry
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Flubendiamide belongs to diamide insecticide that has been used to control a wide range of insects in fruit and vegetables. Assessment for agricultural applicator’s exposure is complicated since the residues accumulated on the treated field was carried out. For dermal exposure measurement, whole body dosimetry (WBD) was performed, which consists of cotton/polyester outer clothing and cotton inner clothes. Hand exposure was measured by washing of nitrile gloves and hands, while head exposure was monitored by face/neck wipe technique. Inhalation exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL with good linearity (R² > 0.99) of calibration curve. Recovery (77%–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–100%). Field exposure assessment was carried out by 8 replicates. During application, total
dermal exposure of flubendiamide was 3635.7 μg, while that of mixing/loading case was 815.3 μg. Hand exposure of flubendiamide (688.7 μg) in mixing/loading was higher than the case of application (680.8 μg). Exposure of body was highest (42.0%) in case of application. Penetration rate of insecticide between outer and inner dosimeter was about 0.5% (upper body) and 5.9% (lower body). Inhalation exposure during application was 20.2 μg while in case of mixing/loading no exposure was observed. Risk index (RI) was calculated to be 0.9 using 6 μg/kg/day of acceptable operator exposure level, suggesting that health risk of agricultural applicator during treatment of flubendiamide for cabbage field would be minimum. Keywords: Flubendiamide, exposure, risk assessment, whole body dosimetry, ISO, cabbage *Corresponding author: kjb2404@stu.ac.kr; Tel, 82-02-880-4644

MO155
Multi-focus FOCUS Surface Water calculations: What do they mean for real regulatory cases?
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The surface water exposure calculations for pesticides according to FOCUS are currently under revision by an EFSA working group. In particular the working group was mandated to extend the calculation period from a preselected single year to 20 years, with the objective to better capture the effect of variable weather conditions in aquatic exposure patterns. This is meant to provide a more robust and reliable basis for aquatic risk assessments in a regulatory context. The planned revision requires decisions on some technical aspects of the calculations (e.g. evaluation of the original FOCUSws weather data, filling of data gaps, completion of irrigation data sets, definition of multi-year application dates) and also new rules for the interpretation of the results. The main challenge in this context is the lack of experience with multi-year FOCUSws calculations. Surface water exposure is strongly driven by individual weather events triggering runoff or drainflow, and depends in a complex way on substance properties and use patterns. Since multi-year calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedure is still missing. In this work we conducted such an investigation by running multi-focus FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns, and by analyzing the resulting exposure patterns. We discuss our experiences with the calculations themselves, and present exposure characteristics of the different test substances. These allow some generic conclusions with regard to the consequences of currently discussed options for multi-year aquatic exposure calculations, and may support the technical and regulatory decisions that the EFSA working group has to take.

MO156
Effectiveness of grass buffer strips in reducing Spinosad runoff
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Outcome from FOCUS and a recent Document from Italian Ministry of Health allows vegetated buffer areas as a mitigation measure for runoff to surface water. The modelling framework includes default values relating to the pesticide removal efficiency of such buffers. Recent research suggests that these default removal efficiencies are not always accurate. For this reason, derived values specific to Spinosad may be useful in demonstrating compliance. A GLP field study was performed in summer 2017 to test vegetated buffer strip removal efficiency, in relation to Spinosad and its major metabolites, and based to the FOCUS Surface Water risk assessment scenarios, but with worse (and prudential) conditions. The selected site was near Verona, in a hilly zone rich in vineyards and famous for high-quality vine production. Runoff containing a known amount of each of the four spinosad components to be tested (the parents – spinosyn A and spinosyn D; and the metabolites – spinosyn B and spinosyn B of D), have been artificially applied to 9 grass plots of 4.2 m width and 12 m length, with sandy soil. Spinosyn D; and the metabolites

MO157
EFSA’s innovative guidance on the establishment of the residue definition for dietary risk assessment
R. Leuschner, EFSA - European Food Safety Authority / Pesticides, Regulated Products (REPRO); A. Friel, EFSA - European Food Safety Authority / Pesticides Regulated Products REPRO

*The positions and opinions presented in this poster are those of the authors and are not intended to represent the views or scientific works of EFSA Commission Regulation (EU) No 283/2013 setting out the data requirements for pesticide active substances provides that the toxicological significance of compounds and their amount likely to be present shall be considered when judging which compounds are to be included in the residue definition for dietary risk assessment. The European Commission, EFSA prepared a guidance on the residue definition for dietary risk assessment which intends to complement the OECD guidance. The EFSA guidance is intended as a practical instrument helping risk assessors, on the basis of factual information (derived from toxicological and metabolism data), non-animal testing methods, by weight of evidence, to transparently: Conclude for which residues of a pesticide on food and feed commodities a hazard identification and characterisation is needed; Perform such a hazard identification and characterisation; Define the compounds that should be included in the residue definition for risk assessment. The innovative aspect of the EFSA guidance is a structured sequence of three modules, each of which addresses hazard characterisation and dietary exposure by selecting genotoxicity as the starting criteria for human health assessment. The modules are: Module 1: Exclusion of genotoxicity; Module 2: General toxicity assessment; Module 3: Decision making for residue definition for risk assessment. The guidance provides as appendices an analysis of ADI and ARfD distribution for pesticide active substances and three case studies illustrating the practical application of this modular approach to derive a residue definition for dietary risk assessment for isoproturon, spiroxamine and enflurazon. In September 2016, EFSA organised a technical meeting with stakeholders on its new guidance to exchange views.

MO158
Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca
C. Secklingham, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; J. Hollender, Eawag / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; V. Kosfeld, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; D. Esser, A. Schulte, Fraunhofer IME; I. Ebersbach, Fraunhofer IME; Institute for Molecular Biology and Applied Ecology; L. Bischof, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology IME. Bioconcentration factors (BCF) are needed for regulatory purposes to assess the bioaccumulative characteristics of a substance in the aquatic environment. Traditionally these BCFs are determined in fish flow-through tests according to TGD OECD 305. These fish bioaccumulation studies are time consuming, expensive, and demand many laboratory animals. Accordingly, alternative methods that replace, reduce and refine (3Rs) this test system are needed. Two promising alternative test approaches have been developed as alternative to in-vitro BCF testing: I) An invertebrate flow-through bioconcentration test system using the freshwater amphipod Hyalella azteca and II) in-vitro depletion assays with rainbow trout hepatocytes or rainbow trout hepatocyte S9 fractions. Flow-through test with almost 20 compounds showed, that the H. azteca bioconcentration test could be an appropriate test to predict bioconcentration in the standard fish test. Bioconcentration studies with H. azteca would support laboratory animal welfare considerations using a non-vertebrate species, improve efficiency and reduce costs for BCF-testing. The results of the in-vitro depletion assays have been successfully applied to improve in-silico predictions for BCF values by adding the highly variable, but context of metabolism and excretion data to in-silico predictions. In this study a total of five substances with different characteristics, four substances with log Kow values ranging from 2.5 to 4.5 and one ionic substance, were tested both test systems. To obtain a more detailed understanding of the metabolic activities in H. azteca, its metabolism of the five tested compounds was compared to the metabolites generated in vitro by rainbow trout hepatocytes. The results show that Hyalella BCF testing, in addition to in vitro assays and in-silico predictions, may help to reduce, refine, and replace the classic BCF estimation with fish in accordance to regulatory needs.
MO159 Assessing Differences in Sensitivity to Aromatase Inhibitors Among Freshwater Fish Species


There is significant concern regarding potential impairment of fish reproduction associated with exposure to endocrine disrupting chemicals (EDCs). Aromatase is a steroidogenic enzyme involved in the conversion of androgens to estrogens. Inhibition of aromatase activity by exposure to chemicals can reduce levels of circulating estrogen leading to reduced synthesis of vitellogenin and production of fewer eggs by females. This mechanism has been extensively studied in the laboratory model species, fathead minnow (Pimephales promelas). However, differences in sensitivity to inhibition of aromatase among species of fish is largely unknown. This is particularly true for species that are not routinely studied in short-term reproduction assays, including many fishes of significant ecological and economic importance such as catfish (Ictaluridae), eel (Anguillidae), and perch (Percaidae). This study investigated in vitro inhibition of aromatase by the model inhibitor, fadrozole, across eighteen phylogenetically diverse species of freshwater fish. Concentrations of fadrozole that result in 50 % inhibition of in vitro aromatase activity were determined. The concentrations of the inhibitor required to inhibit aromatase were comparable among paddlefish, white sucker, rainbow trout, and fathead minnow despite up to 40-fold difference in sensitivity to fadrozole. This suggests that relative potencies generated for a model species, such as fathead minnow, could be applicable across diverse species, despite great differences in relative sensitivity. Results of this study are being used in the construction of a cross-species quantitative structure-activity relationship (QSAR) model for the inhibition of aromatase activity as a relative-sensitivity-adjustment for prediction of impacts at the individual and population level. This information could guide more objective ecological risk assessments of native species to EDCs that inhibit aromatase. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO160 Fish scales as a tool for temporal biomonitoring of trace element concentrations

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Direct measurement of contaminant concentrations in biological tissues is attractive for toxicology purposes because it accounts, in principle, for the environmental factors controlling their bioaccessibility and bioavailability. In the case of trace elements, the validity of this approach is confirmed by its adoption in the regulatory European framework for mercury measurement in fish. For other elements, the current framework privileges measurements in the dissolved (filterable) aqueous matrix. However, this approach provides only a limited temporal resolution of possible trends in elements’ concentrations and, where relevant, neglct uptake via dietary pathways. Furthermore, when fish is the selected matrix for monitoring, one or more individuals have to be sacrificed to collect the material necessary for analysis; a strategy that, apart from the associated ethical problems, may become problematic in situations where the number of resident fishes is limited. In this context, there is a growing interest in the use of fish scales as a non-lethal, rapid and efficient alternative for monitoring trends in trace element levels in a reservoir receiving cooling waters from a nuclear power generation plant. The variations in the concentrations of Cu, Zn and lanthanides were followed in fish scales from archived fish material (Abramis brama) collected annually between 1990 and 2016. Scales were dried, calcinated and mineralised using concentrated nitric acid. After digestion, Cu and Zn were assayed by atomic absorption spectroscopy and lanthanides by ICP-MS. For Cu and Zn, triplicate measurements generally agreed to 10% and accuracy, with respect to the standard reference material TORT2 (lobster hepatopancreas), was between 90%. In the course of lanthanides, analysis were made on one sample per year and only La, Ce, Pr, Nd, Pm, Sm, Eu and Gd could be systematically quantified. Overall, fish scales proved to be a suitable matrix for the biomonitoring of trace element concentrations, including elements of emerging concerns such as lanthanides. Compared with fish muscle (or whole fish), fish scales are easier to preserve (no need for dissection, freezing and lyophilization) and, in some situations, may even allow repeated surveillance of the same individuals. This methodological validation study paves the way to further research to establish relationships between accumulation in scales, internal organs and biological responses.

MO161 Assessing differences in sea turtle organ sensitivity using cell-based toxicity assessments

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The long-lived nature of sea turtles and their lengthy residence in coastal foraging grounds can result in high exposure to contaminants from urban, industrial and agricultural sources. Organic or inorganic contaminants have been quantified in all species of sea turtles worldwide. However, very little is known about how these contaminants impact turtle health, valuable information for identifying populations at risk. In vitro exposure experiments using cell cultures established from turtle tissue provide an ethical, reproducible and cost-effective method to identify threats of environmentally relevant contaminants to sea turtles. In recent years, the majority of sea turtle cell lines have been established from skin samples. However, as ingestion is the main route of exposure for these animals, cell cultures established from organ tissues may be more pertinent. This study used a number of primary cell cultures established from the skin, ovary, heart, liver and small intestine from three individual green turtles to investigate the variation in sensitivity between organ types. Cytotoxicity of five organics and five inorganic compounds was investigated using a total of 13 cell chons. Differences between cell lines were investigated based on their order of sensitivity to all compounds tested. The results were then used to assess risks to sea turtle populations worldwide. The results provide recommendations for further toxicological studies involving turtle cell lines that will allow more robust and meaningful risk assessments to be conducted for sea turtles, assisting conservation and management strategies worldwide. Our results also support the use of sea turtle cell cultures as an ethical and reliable method for investigating toxicological effects of environmental contaminants.

MO162 Comparison of rat liver S9 to an animal-free alternative ewoS9R in the Ames fluctuation assay

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The Ames test is the most important in vitro test for mutagenicity performed in many variants. The original agar-plate assay was modified to reduce the amount of assay components like rat liver S9 and the length of time needed for test preparation and evaluation. The Ames fluctuation test was established as a less time and material consuming method and introduced into international guidelines like OECD 471 and ISO 11350. In the Ames test the bacterium Salmonella typhimurium, with a lack of histidine-synthesis, is exposed to a sample to determine the mutagenic potential, measured by the ability of revertant bacteria to synthesized histidine. The resulting growth in a histidine-free medium is visible due to a colour change caused by acidification in a pH indicator medium. Nevertheless, it can be further improved and combined with the RAMOS-technique (Respiration Activity Monitoring System). This technique improves the sensitivity and the data output of the fluctuation variant. It enables a precise measurement of the oxygen transfer rate (OTR) and therefore conclusions on growth and metabolism of the bacterial culture. Furthermore, it can be implemented as an online-monitoring system on mutagenicity in applications like drinking water monitoring. However, as the Ames test is conducted with a microorganism, it lacks the metabolic activation of a mammalian metabolism. Hence, the mutagenicity of promutagens would be underestimated. Therefore, the bioassay is supplemented with an animal-derived product the rat liver S9. In animal experiments rats are treated with toxic substances via percutaneous or intravenous injections or feeding. Subsequently, the animals are euthanized to obtain the liver, which is homogenized, centrifuged and frozen. The commonly used rat liver S9 is a necessary component in various tests to assess the mutagenicity of environmental contaminants. The Ames test used a number of primary cell cultures established from skin samples. However, as ingestion is the main route of exposure for these animals, cell cultures established from organ tissues may be more pertinent. This study used a number of primary cell cultures established from the skin, ovary, heart, liver and small intestine from three individual green turtles to investigate the variation in sensitivity between organ types. Cytotoxicity of five organics and five inorganic compounds was investigated using a total of 13 cell chons. Differences between cell lines were investigated based on their order of sensitivity to all compounds tested. The results were then used to assess risks to sea turtle populations worldwide. The results provide recommendations for further toxicological studies involving turtle cell lines that will allow more robust and meaningful risk assessments to be conducted for sea turtles, assisting conservation and management strategies worldwide. Our results also support the use of sea turtle cell cultures as an ethical and reliable method for investigating toxicological effects of environmental contaminants.

MO163 QSAR: a predictive approach for electronic cigarettes toxicological assessment

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Electronic cigarettes (e-cigarettes) are devices that typically deliver nicotine, flavorings, and other additives to users via an inhaled aerosol. They are designed to closely mimic the experience of smoking conventional cigarettes. Nowadays, e-cigarettes are the most commonly used tobacco-related product among youth, surpassing conventional cigarettes in 2014. However, insufficient data is available to draw firm conclusions about the public health risks associated with the inhaled aerosols to which consumers are exposed; at the same time studies evaluating whether e-cigarettes are less harmful than cigarettes are inconclusive. Minimal valid chemistry data are available on e-cigarette emissions and no standardized methods and threshold values exist for e-cigarette analysis. To fill the chemical and toxicological data gap, we comprehensively assess e-cigarette chemical emissions and toxicological studies are certainly needed. The aim of the present study is to provide, by means of Quantitative Structure-Activity Relationship (QSAR) approaches, a first toxicological screening of several e-liquids ingredients. Different Ordinary Least Squares (OLS) regression-based QSAR models were developed to define the potential acute toxicological profile of 265 molecules contained in 72 e-cigarettes, some of which are marketed as ‘nicotine-free’. NOEC (C/M) was determined. For ECOSAR daphnia model, 82 out of 126 values of target substances are within the lowest and highest values of the category domain. In o...

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MO165

MO166

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environmental disease. Epidemiological evidences show that the disease is associated with exposure to hazardous chemicals. However, causal relationship has not been clearly understood. In the present study, we aimed to elucidate the link between occurrence of metabolic or neuro disease and exposure of environmental chemicals. We first screened potential of environmental chemicals on the disease model organisms, *C. elegans* and Zebrafish. To maximize the advantage of these model organisms, we conducted toxicity screening using *C. elegans* mutants; oga-1(ok1207), ogt-1(ok1474), ngl-1(ok259), transgenic zebrafish, Tg(T2KinsfsB-mCherry)48 and Tg(elavl3:EGFP)Knu3. The highly conserved O-GlcNAc transferase; OGt and O-GlcNACase; OGA genes are related to type 2 diabetes and null mutations cause alterations in *C. elegans* carbohydrate and lipid metabolism. Neurologin NLG-1 control synaptic function, which is conserved from neurotodies to mammals to target alterations in nicotinic receptor toxicity (ADHD). Tg(T2KinsfsB-mCherry)48 fish express insulin nitroreductase(InSNT) mcherry fusion protein in the pancreatic β-cell and Tg(elavl3:EGFP)Knu3 fish express GFP in most post-mitotic neurons. Various category of environmental chemicals, such as, heavy metals (i.e. arsenic, lead, cadmium), EDGs (i.e. Nonylphenol, Bisphenol-A,EDF) and biocides (i.e. Chlorophenol, CMIT/MIT, PCH), were screened using *C. elegans* reproduction assay and zebrafish transgenic assay. The preliminary results showed CMIT/MIT and BPA reduced fluorescence intensity of insulin gene in zebrafish, suggesting possible involvement of these chemicals on metabolic pathways. In brief, our results suggest multi-model approach could complement the limitations of a stand-alone model organism and thus more accurately identify chemical hazard on human health. Therefore, the outcome of the current study could be utilized for efficient chemical screening and better risk assessment of the chemicals. Acknowledgement: This work was supported by the Mid-career Researcher Program (2017R1A2B3002242) through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning.

MO168

In vitro effects of two pesticides on the motility and viability of bovine spermatozoa
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The use of plant protection products has exponentially increased in the agricultural sector over the past decades. Copper sulfate and glyphosate are two commonly used pesticides, the former as fungicide and the latter as herbicide. Farm animals may be exposed to this type of products through different ways: i) the drift of pesticides during their application may lead to inhalation or dermic exposure or ii) through the ingestion of plant residues. This exposure may affect the reproduction of those animals. Actually, spermatozoa are extremely sensitive to slight variations in the organism. The interaction between chemicals and sperm may alter its mobility; velocity and/or viability depending on which cell structures are affected. This work aimed at assessing the toxicity of ecological relevant concentrations of copper sulfate and glyphosate on bovine spermatozoa. Commercial frozen semen from five different bulls was exposed to three different concentrations of the two pesticides, diluted in phosphate-buffered saline (PBS), plus a control (PBS). For each bull, three replicates were made. Motility and velocity endpoints were measured with a sperm analyzer computer program and viability was measured using an eosin-nigrosin staining procedure. Endpoints were measured at 0, 30 and 90 minutes. Copper sulfate did not induce significant effects on cell viability but reduced the number of animals used in environmental testing, data from *in vitro*, *in vivo* and *in vivo* assays have been developed to support a weight of evidence approach to assess bioaccumulation potential in fish. A draft guideline entitled, Determination of *in vitro* intracranial clearance using cryopreserved hepatocytes (RT-HEP) or liver S9 sub-cellular fractions (RT-S9) from rainbow trout and extrapolation to *in vivo* intracranial clearance is currently undergoing OECD review. The procedures as outlined in this draft guideline were used to determine measured *in vitro* intracranial clearance rates. These rates were then used to predict fish BCf values for several active pharmaceutical ingredients for which *in vivo* clearance and fish BCf values have been determined as per the OECD 305 Guideline. The outcome of these in *vivo* assays will be presented along with the in *vivo* BCF data.

MO170

Chemoavailability of Organic Electrolytes - A Nonanimal Nonassay Approach to Identify Candidates for Reactive Toxicity
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Organic electrolytes are important components within the exosomizes of humans, flora and fauna. Their toxicity toward aquatic organisms is driven by two molecular initiating events (MIE): the hydrophobicity-triggered disturbance of cellular membranes and the chemistry with nucleophiles, such as, the DNA. The toxicity enhancement *T*, which indicates the ratio of narcosis baseline (hydrophobic MIE) vs. experimental in vivo or in vitro bioassay toxicity, has been used as a measure for the reactive MIE for many years. However, very early studies already showed that *T* does not solely depend on reactivity, but also decreases with increasing hydrophobicity. This indicates that the relevant nucleophilic targets are located in aqueous compartments and that the hydrophobic and the reactive MIEs do not contribute independently to overall toxicity. In this communication, we employ our concept of chemoavailability to a set of 58 Michael acceptors, in order to analyze the impacts of reactivity and hydrophobicity on the overall toxicity as well as on *T*. To this end, reactivity was quantified by the second order rate constant for the reaction of the Michael acceptors with glutathione (GSH). A hydrophobicity through the octanol/water partition coefficient and toxicity through the 48-h-effect concentration yielding 50% growth inhibition of *Tetrahymena pyriformis*. The results demonstrate that the decreasing *T* with increasing *k*<sub>woe</sub> is caused by a rate-determining transfer-step of the electrophile from lipophilic compartments into the aqueous cytosol. Finally, chemoavailability, as a trade-off between log *k*<sub>ow</sub> and log *k*<sub>woe</sub>, is shown as promising nonanimal tool to analyze whether aquatic toxicity is predominantly driven by the hydrophobic or the reactive MIE, or by both MIEs working in parallel. The authors thank the EU-funded project ORISIR (GOCE-CT-2007-037017) and the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Mulliner D, Schüürmann G 2013. Mol. Int. 32: 98-107. [2] Böhme A, Laqua A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [3] Laqua A, Thaens D, Paschke A, Schüürmann G 2009. Chem. Res. Tox. 22: 742-750.

MO171

Local Electrophilicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward *Tetrahymena pyriformis*
D. A. Meo, UFZ - Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

Eutrophic compounds such as α,ω-unsaturated carboxyls are valuable reactants in organic synthesis and commonly used as industrial intermediates and products. At the same time, their electrophilic reactivity may become critical in case of uptake into organisms because of the ubiquitous presence of nucleophilic sites in proteins and the DNA. The toxicity enhancement *T* is related to the reactive MIE. However, the fragment molecular electrophilicity (FMI) has been used as a measure for the reactive MIE for many years. This work developed a new concept of electrophilicity based on the experimental reactivity of aquatic toxicity. For this purpose, the correlation with logarithmic reaction rate constants toward Glutathione (GSH) was analyzed. GSH is a small tripeptide which acts as a protector against electrophiles in the cytosol. The dataset of aquatic chemicals contained 97 α,ω-unsaturated esters, ketones and aldehydes. In the context of aquatic toxicity toward *Tetrahymena pyriformis*, reactive toxicity is assumed to be the primary mode of action of the aforementioned compound classes. Therefore, the descriptive power of calculated and experimental GSH reaction rate constants was compared. Both models perform equally well and yield root mean squared errors of about 0.4 log units in modeling the toxicity enhancement as deviation from narcosis level based on 48h-inhibition-growth concentrations.

MO172

Using mechanisms of toxic action to classify and predict ester ecotoxicity
P. Bichérel, P. Bauer, KREATIS; P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment

Even though esters are often used and released into the environment, little is known about the mechanisms of toxic action towards aquatic and terrestrial animals. Esters are considered to exert a specific narcosis, while some other esters can exert toxicity related to their potential reactivity. Therefore the critical step, before predicting the toxicity of an ester, is to determine its mechanism of toxic action (MechA). For this purpose the classification of Baur et al., (2018) is used in combination with an accurate modelling approach which is derived from empirical data specific to the MechoA. The acute toxicity of esters to aquatic flora and fauna may be regressed against a hydrophobicity descriptor (i.e. log *K*<sub>OW</sub> or water solubility), and compared with similar regressions for non-polar narcotics. The similarity between these regressions confirms non-reactive esters are simple
narcotic compounds for algae but not for fish or daphnids. For the animal species, the regressions for esters are not the same as for narcotic compounds. The most likely explanation for this difference is the balance between hydrolysis rate and the toxic action of the parent and the degradation products. That is why they are considered as pronarcotics. A toxicity to algae in line with a narcotic mode of action suggests that the enzyme responsible for hydrolysis found in fish and daphnids is also responsible for the hydrolytic activity of esters in algae. In this case, the *di*-esters appear to be more toxic than *mono*-esters for fish and daphnids because they can produce two times more metabolite than *mono*-esters. The more reactive esters are usually unsaturated, like allyl/vinyl-*di*-esters and alpha,beta-unsaturated esters, whose double bond can be activated by the carbonyl group. For these compounds the substitution around the double bond plays a decisive role in effective reactivity. Thus, methacrylates which have an alkyl substituent in position alpha of the carbonyl are not more toxic than aliphatic esters for any of the three aquatic species. On the other hand, Acrylates clearly express excess toxicity and have to be considered as acting through yet another mechanism of action relating to a model dedicated to soft electrophiles. Rather than model the toxicity only according to structural analogy, a modelling approach is used to develop QSARs for esters based on three pillars: structure, mechanism and species metabolism.

MO173 Nanoendose pulsed electric field incorporation technique to predict molecular mechanisms of teratogenicity and developmental toxicity on fish embryos
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We developed and applied the nanoendose pulsed electric field (nPEF) treatment condition and assessed the teratogenicity and embryonic developmental toxicity by chemicals using fish embryos. Furthermore, we analyzed gene expression profiles in fish embryos using DNA microarray and performed pathway and network analyses to understand the molecular mechanisms of chemicals in teratogenicity and embryonic developmental toxicity. Our findings suggested that the nPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MO174 Moving 3D in vitro intestinal models forward: transcriptional characterization of the RTgutGC cell line
L.M. Langen, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences

Intestinal derived cell lines are useful in *in vitro* models which allow for focused investigation on individual cells. National interest in the intestine, the digestive tract, continues to grow. The development of the first immortalized intestinal cell line derived from the rainbow trout (RTgutGC) offered an opportunity to explore intestinal uptake without the need for numerous animals. Recent work using numerous compounds has acknowledged its potential as a replacement tool for animal based laboratory studies, there is still a lot to be explored before its widespread incorporation as a standard tool. Cell lines are known to acquire additional mutations or modifications while in culture, and it is important to understand to what extent this cell line retains the genetic landscape of primary intestinal tissue. In this study, RNA-Seq sequencing of the RTgutGC cell line was used to establish gene expression in this potential animal replacement model. Over 84% of the sequences were mapped to the genome. Following filtering for transcript abundance using TPM (transcripts per million), 24,890 contigs were identified and blasted against the NR database. InterProScan was run in parallel to blast annotation and later merged with the genome. Over 43 genes were shown to be differentially expressed in the RTgutGC cell line. InterProScan was run in parallel to blast annotation and later merged with the genome. Following filtering for transcript abundance using TPM (transcripts per million), 24,890 contigs were identified and blasted against the NR database. InterProScan was run in parallel to blast annotation and later merged with the genome. Following filtering for transcript abundance using TPM (transcripts per million), 24,890 contigs were identified and blasted against the NR database.
to other species. The O:N index had values below 9 fact indicates that organisms were in a high degree of stress. Growth rates of intoxicated organisms were between 19 to 49% lower than those observed in the control group. The average concentrations of Tbars registered organisms varied from 2.5 to 25.6 nM Tbars mg⁻¹ and show a direct dose-response relationship, since when increasing the time of exposure to DDPV increased the degree of lipid peroxidation in the tissues. A decrease in ACh activity was observed in perch between 22 and 45% and fish from 22 to 35%. The results of this study indicate that the effects of the pesticide DDPV are likely irreversible in some species.

**MO178**

Characterising estrogenic activity of arctic char tissue extracts in two fish in violin codasays


Contaminants from anthropogenic activities find their way to the Arctic through long range atmospheric transport, ocean currents and via transport by living organisms (migrating fish or seabirds). Although the levels of POPs in arctic fish are generally low, local hot-spots of contamination have been demonstrated in freshwater systems affected by seabird guano, such as Lake Ellasjøen at Bear Island (Norway). High concentrations of organic halogenated compounds have been measured in resident populations of Arctic char. Accumulation of dioxin-like compounds up to 8 times higher levels than the lowest observed effect level for egg mortality in temperate salmonid fish raise concern that residential Arctic char might be at risk for adverse effects at the individual and population level. In this study the aim was to compare the toxicity potencies of pollutants in Arctic char from the contaminated Lake Ellasjøen with those from the less contaminated Lake Laksvatn at Bear Island. This was done by in situ sampling, extraction, and fractionation of liver tissues. From the following fractions (F): F1- F6 were produced: F1: nonpolar POPs such as PCBs, PBDEs and most of the nonpolar pesticides, F2: polar pesticides and metabolites of POPs, F3: polar POPs (phenolics such as chlorinated phenols and hydroxylated metabolites of PCBs and PBDEs). A method for isolation, cultivation and exposure of primary hepatocytes from Arctic char was developed together with the established method for primary hepatocytes from rainbow trout to investigate cytotoxic and estrogenic effects of the fractions. The estrogenic potency, measured as induction of the estrogen receptor (ER)-mediated production of vitellogenin (Vtg), was higher in liver extracts from Lake Ellasjøen than Lake Laksvatn. Although primary hepatocytes from both species displayed estrogenic activity in response to the F3 fraction similar to that observed in the rainbow trout hepatocytes than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible for cytotoxic effects than rainbow trout hepatocytes. F3 and F2 from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F3 having largest effect. Chemical analysis was performed to identify potential contributors to the observed effects of the fractions. The project was funded by the Norwegian Research Council, project. No. 221373.

**MO179**

Ultrasound: A novel approach to non-lethally measure hepatosomatic index in sentinel fish for environmental monitoring programs

A. Gjøs, University of British Columbia / Fisheries and Oceans Canada; V. Palang, ISD-Experimental Lakes Area; P. Borrett, University of Saskatchewan; L. Hrenchuk, ISDEExperimental Lakes Area; M. Murdoch, Stantec Consulting Inc; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences Canada’s environmental effects monitoring (EEM) program studies impacts of metal mining and pulp mill effluents on aquatic receiving environments. The EEM regulations recommend lethal sampling of 20 fish (male and female) of different species to study body condition, liver size (hepatosomatic index-HSI), and gonad size (gonadosomatic index-GSI) during every monitoring cycle. Developing and implementing non-lethal methods for environmental monitoring programs provides an opportunity to protect sentinel endangered fish which might be threatened by researchers handling of the fish. Ultrasound was observed in rainbow trout that are part of systems with low productivity. Ultrasound is a non-invasive tool that has been tested to assess gonad size in fish. Currently, its potential as a non-lethal tool in environmental monitoring programs is not well explored. We conducted feed withdrawal studies in the laboratory to test the accuracy and sensitivity of ultrasound to measure HSI in sentinel fish with a compact liver such as rainbow trout (Oncorhynchus mykiss). With the ultimate goal of providing empirical evidence of the applicability and ease of this technique in the field, we also tested the accuracy of ultrasound method to measure HSI in lake trout (Salvelinus namaycush) at ISD-experimental lakes area. Our laboratory studies provide a significant correlation for the accuracy (HSI, r²=0.73, n=16, p< 0.05) and evidence for the sensitivity of ultrasound method (p=0.06, n=7) versus traditional lethal gravimetric method (p=0.05, n=7) to measure HSI within the acceptable critical effect size for HSI mandated by EEM. Our field ultrasound method testing also revealed a significant correlation between the traditional lethal and ultrasound method in measuring HSI (r²=0.81, n=9, p< 0.05) in lake trout. Our field analyses provide evidence for the ease and potential application of this technique for future environmental monitoring programs. Our ongoing method refinement and exploration of this technique in sentinel fish with diffuse livers across different size ranges will strengthen our goal of proposing ultrasound as a viable non-lethal alternative to measure HSI on a global scale.

**MO180**

Weight of evidence for fish acute toxicity: a Bayesian network modelling approach

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Reduction of animal testing wherever possible is requested by EU Directive 2010/63/EU. Fish Embryo Toxicity (FET) testing can be an alternative to using juvenile fish in acute toxicity testing. However, FET data are currently not accepted as a replacement to juvenile fish acute toxicity data for regulatory purposes such as REACH, without sufficient weight of evidence (WoE). The development of a WoE approach for FET data has been recommended by the European Chemicals Agency to significantly reduce the number of animals required for hazard assessments of chemicals. We propose a Bayesian network (BN) modelling approach for quantifying the weight of evidence. BN is a probabilistic modelling methodology which is an increasingly used in ecological risk assessment as well as in environmental management and assessments, depending upon the purity of the proposed BN model is to integrate information from large and varied ecotoxicological and physico-chemical datasets, and apply it in a WoE approach to predict fish acute toxicity of chemicals from data on fish embryo toxicity testing in combination with other relevant information. The planned steps of the model development and application are: (1) Identification of suitable chemical properties and endpoints as nodes for the BN. (2) Compilation of data on ecotoxicity data for fish embryos and other relevant information. (3) Construction of a BN model for integrating the data and other information in a probabilistic framework. (4) Evaluation of the WoE approach using ecotoxicity data for fish embryos in combination with data on (juvenile) fish acute toxicity. (5) Application of the BN model to assess the risk of various contaminants based on chemicals registered in the European Chemicals Agency database (http://echa.europa.eu).

**MO181**

Divergent immunomodulatory effects of cadmium between two marine immune cell models in vitro, macrophages and mast cells.

M. Doubravcova, Wageningen University; V. Harju, NILU Norwegian Institute for Air Research; N. van den Berg, N. van den Brink, Wageningen University / Dept of Toxicology. Cadmium can induce toxic effects via different mechanisms, e.g. depletion of cellular antioxidants leading to increase of ROS levels and induction of apoptosis. Such effects have been addressed in different types of tissues and cells, including the immune system. However, these mechanisms of toxicity may have different impacts on physiological and pathophysiological processes. The aim of this study was to evaluate the potential cellular and tissue-specific effects of cadmium on primary immune cells part of the first line of defence, able to initiate fast inflammatory responses. Each cell type acts via different mechanisms involved in the defence against intracellular bacteria and infected cells, carried out especially by phagocytes like macrophages. In contrast, mast cells are associated with type 2 or humoral/antibodies-mediated immunity, concerned with extracellular pathogens and parasitic infestations. In order to study the immunomodulatory effects of cadmium on macrophages and mast cells we carried out a mechanistic in vitro study. Exposure to cadmium depleted glutathione in the four cell lines tested, potentially modulating functional parameters in macrophages mainly as a result of activation of redox-sensitive pathways leading to pro-inflammatory effects. Mast cell showed steeper GSH-depletion, compared to macrophages, prior to the onset of cytotoxicity, indicating increased ROS levels, resulting in potentially increased oxidative stress. A dose-response inhibition in the secretion of histamine was shown, suggesting that mast cell function could be impaired by cadmium. In this way, cadmium may modulate the function of the innate immune system, in such a way, that favours to a type 1 response by enhancing macrophages responses and at the same time affecting the functioning of mast cells.

**MO182**

Changes in protein expression of primary sea turtle cells exposed to contaminants from the two fish populations. The following fractions (F) were identified in ACh activity was observed in perch between 22 and 45% and fish from 22 to 35%. The results of this study indicate that the effects of the pesticide DDPV are likely irreversible in some species.

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The development of biomarkers of chemical exposure and effect in threatened wildlife is challenging because traditional methods for biomarker discovery that involve in vivo testing or destructive sampling cannot be utilized. These challenges have long since been acknowledged and the development of non-destructive methods for the detection of biomarkers in wildlife has been examined for many decades. However, despite these efforts, progress in this field has been slow and the development or improvement in non-destructive methods to detect levels of exposure in threatened wildlife has been limited. The usefulness of cell lines along with non-targeted omics has not been well explored in this context despite the potential for these methods to greatly enhance non-destructive biomarker development. In order to assess the potential of these methods for the development of biomarkers of exposure and effect, we optimised exposure and extraction methods and aimed to investigate the effect of time and dose on protein expression and DNA content. Our results show that a large number of proteins, over 700, were significantly differentially expressed by cells under exposure conditions and that time and concentration had significant effects on overall differential expression as well as on the expression of individual proteins. Most significantly, a biomarker of PCB exposure that has previously been identified in sea turtles (speroxide dismutase) was expressed by cells exposed to PCBs indicating that these methods can potentially reflect biomarkers measured in whole organisms. Overall, the results from this study provide insight into the effects that time, dose and treatment have on global protein expression of green sea turtles, as well as preliminary evidence for the usefulness of non-targeted proteomics for biomarker discovery. This indicates the potential of the methods described here to support higher throughput confirmation of biomarkers of exposure and effect while reducing the need for invasive sampling on threatened wildlife.

MO183 Baseline vs. Reactive Toxicity toward the Nematode C. elegans as Alternative Bioassay
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The nematode Caenorhabditis elegans is the first multicellular organism with a completely sequenced genome. Since more than 20 years, it has been employed as a model system for assessing the environmental toxicity associated with sediments. Despite a large amount of studies with this worm, it is the first multicellular organism with a completely sequenced genome. Since more than 20 years, it has been employed as a model system for assessing the environmental toxicity associated with sediments. Despite a large amount of studies with this worm, it has long been acknowledged and the development of non-destructive methods to detect levels of exposure in threatened wildlife has been limited. The usefulness of cell lines along with non-targeted omics has not been well explored in this context despite the potential for these methods to greatly enhance non-destructive biomarker development. In order to assess the potential of these methods for the development of biomarkers of exposure and effect, we optimised exposure and extraction methods and aimed to investigate the effect of time and dose on protein expression and DNA content. Our results show that a large number of proteins, over 700, were significantly differentially expressed by cells under exposure conditions and that time and concentration had significant effects on overall differential expression as well as on the expression of individual proteins. Most significantly, a biomarker of PCB exposure that has previously been identified in sea turtles (speroxide dismutase) was expressed by cells exposed to PCBs indicating that these methods can potentially reflect biomarkers measured in whole organisms. Overall, the results from this study provide insight into the effects that time, dose and treatment have on global protein expression of green sea turtles, as well as preliminary evidence for the usefulness of non-targeted proteomics for biomarker discovery. This indicates the potential of the methods described here to support higher throughput confirmation of biomarkers of exposure and effect while reducing the need for invasive sampling on threatened wildlife.

MO184 Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Nonanalytical Tool for Mimicking Phase I Metabolism
J. Moldrickx, Helmholtz centre for environmental research - UFZ / Ecological chemistry; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; A. Becker, Leipzig University; G. Schüürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The electrophilicity of a chemical substance can have a significant impact on its toxicological profile, as this property determines the chemical’s ability to form adducts with electron rich sites of proteins, lipid components, DNA and RNA. In many cases, this type of adduct formation is the molecular initiating event (MIE) of a complex adverse outcome pathway. Kinetic chemosays, which address this type of MIE, are used for the quantification of a test chemicals’ reactivity towards typical biological targets, and have facilitated the development of e.g. models for the prediction of the aquatic excess toxicity or skin sensitization potential. Apart from chemicals that possess electrolytic substructures in their initial form, there are compounds that can become electrophilic only after abiotic or biotic oxidation. The reactive toxicity of these chemicals, also described as pro-electrophiles, is often difficult to characterize with simplified model systems like chemosays or in vitro bioassays because these methods typically do not sufficiently include an activation step. Our presentation introduces a new tool, based on an Fe-loaded zeolite, that is able to mediate the transformation of pro-electrophoric phenol and dihydroxybenzene derivatives into potent electrophiles. The reactive electrophiles are trapped by coincubation with the tripeptide WCG (tryptophan, cysteine, glycine) and analyzed using high performance liquid chromatography coupled to tandem mass spectrometry. Profiling of the obtained adduct patterns enable the identification of formed electrophiles, and provides new insights into the oxidation pathways causing the reactive toxicity of pro-electrophiles. The authors acknowledge the EU-funded project OSIRIS (GOCE-CT-2007-037017) and the BMBF-funded project ProHapTox (FKZ 031A22A and 031A22B) for financial support. [1] Böhme A, Laqua A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [2] Mulliner D, Schüürmann G 2013. Mol. Inf. 32: 98-107. [3] Chipinda I, Ajibola R, Morakanyi MK, Ruwbona TW, Simonyi RH, Siegel PD 2010. Chem. Res. Toxicol. 23: 918-925. [4] Böhme A, Thaens D, Paschke A, Schüürmann G 2009. Chem. Res. Tox. 22: 742-750.

MO185 Integrated assessment of aquatic ecotoxicity for regulatory purposes
c. cappelli, IRCCS Istituto di Ricerche Farmacologiche Mario Negri; C. Toma, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; A. Manganaro, Kode s.r.l.; D. Gadaleta, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

The REACH regulation requires the assessment of the CMR and PBT properties of the chemicals produced or imported in EU in amounts exceeding 10 t/a in order to protect the human health and the environment. The JANUS project aims at the development of a JAVA application to prioritize and assess the chemicals according to the PBT, CMR and endocrine disruption properties with uncertainties estimation. To assess the ecotoxicity part of the Toxicity, we developed six continuous QSAR models for acute and chronic aquatic endpoints for the main trophic levels: EC<sub>50</sub> 96th and NOEC 96th algae (Raphidocelis subcapitata), EC<sub>50</sub> 48h and NOEC 21d Daphnia magna, LC<sub>50</sub> 96th fish (Oryzias latipes) and NOEC fish (more fish species). We used gaselect and VSURF to select the DRAGON descriptors and the tree ensemble (random forest) method to derive the models, obtaining good performance (R<sup>2</sup> up to 0.96 on the training set and up to 0.78 on the validation set when the applicability domain is considered). We used the three new QSARs on chronic endpoints to perform the assessment of chemicals; we used the three new QSARs and the seven ones implemented in the VEGA platform (https://www.vegahub.eu/) on acute endpoints for screening purposes (two QSARs for Daphnia magna, two generic QSARs for fish, three QSARs for specific fish species). The ecotoxicity workflow is divided in three parts: algae, Daphnia magna and fish. For each part and each endpoint, the workflow integrates the experimental values (if any), the QSAR predictions and their reliabilities. The experimental values have a higher reliability than the predictions. The reliability takes into account the intra- and inter-specific variability, the most sensitive species and the applicability domain index of the predictions. The users can choose a consensus or a weighted prediction approach. The experimental values and the predictions are weighted according to the regulatory thresholds to verify if the ecotoxicity criterion is fulfilled for each trophic level. The final assessment for ecotoxicity is based on the integration of the assessment of the trophic levels (the values and their reliabilities) and the number of trophic levels that fulfil the ecotoxicity criteria. The scheme will be applied to other categories of chemicals, such as the biocides within the LIFE COMBASE project. The authors thank the projects JANUS (contract Z 6 80 710/20 - 3716 65 414) funded by Umweltbundesamt (UBA) and LIFE COMBASE (LIFE15 ENV/ES/416) for the financial support.
Aquatic toxicity testing with algae, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isoocet and isoundecan. The study objective was to employ a testing program consisting of long-term fish (limit test), invertebrate and algal toxicity tests to demonstrate that QSR estimations accurately predict aquatic effects from long-term continuous exposure to these substances, further supporting the use of QSR models across a range of issue targets. To this date, all data demonstrate that the QSR model employed accurately characterized the hazard of iso-alcohols and is protected of these endpoints. Moreover, this combined information, by demonstrating a regular and predictable pattern of toxicity amongst these substances, further justifies read-across between substances for other endpoints (such as bioaccumulation) and supports efficient use of data for general purpose risk assessments.

MO187 Looking for an alternative to glyphosate-based herbicides
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Glyphosate-based herbicides are widely used in agriculture. When these products were originally introduced to the market, they were intended to affect only target species i.e. plants. However, over the past decades there is growing evidence on the toxicity and genotoxicity of glyphosate on non-target species. On 27th November 2017 the EU member states agreed on a five-year renewal period for the use of glyphosate based herbicides. However, in case glyphosate-based herbicides become prohibited eventually, the availability of alternative active substances will become an urgent need. Nonanonic acid (a.k.a. pelargonic acid) is a biologically derived substance considered as an environmental friendly herbicide. Its toxicity level to mammals is low and is also not expected to have adverse effects on non-target organisms. The aim of the present study was to compare the toxicity levels of glyphosate and a glyphosate based herbicide against pelargonic acid and a pelargonic acid-based herbicide on aquatic ecosystems using zebrfish as a model organism. In order to do so, we investigated the effect of both active substances and their formulations on the developmental stages of zebrafish embryos (OECD Guideline, Test No 236). The corresponding values of LC₅₀ were calculated. The larvae that hatched from the acute toxicity tests were recorded in the observation chamber DanioVision and their swimming behavior was estimated in EthoVision software. The potential effect of the tested substances on the respiratory system of aquatic organisms was investigated in vitro by performing the Neutral Red Uptake assay on the trout-derived gill cell line RTgill-W1. Results of our in vivo and in vitro tests indicate that pelargonic acid and its formulation are more toxic (acute toxicity) than glyphosate and its based-herbicide. Furthermore, the behavioral assay indicates a potential for a neurotoxic effect of pelargonic acid on zebrafish larvae. To our knowledge so far there are no available data for a neurotoxic effect of pelargonic acid on aquatic organisms. Hence, this outcome has to be further investigated. Financial support from the City of Vienna project Ökotoxikologie (MA 23 - Project 15-06) is gratefully acknowledged.

MO188 Chemosassay Profiling of Salicylates to Assess their Reactive Toxicity
A. Werner, Leipzig University; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
Salicylates are widely used as fragrance additives or UV light absorbers in cosmetics and consumer care products, and thus can contribute to the human exposome. Moreover, they are released into the environment from various industrial sources and their metabolites are also excreted in faeces. The XETA assay was thus employed to provide information on the potential of a test substance or a sample to alter the normal functions of the thyroid system. The XETA provides a rapid (<72h) way to measure the response of embryonic stage tadpoles to potential thyroid disrupting chemicals, allowing a efficient method for screening thyroid disruptors. XETA could provide an alternative to complex in vivo tests. It can be used for screening large number of molecules or testing environmental samples that couldn't be stored or sampled in large quanitities. OECD is currently validating this in vivo assay, the final stage of validation has been completed in 2017 and it is expected that the XETA may be approved as an OECD Test Guideline by 2019. OCDE validation focus on using the XETA to test pure chemicals but this test could be particularly useful for the hazard assessment of effluents. During the past 12 years we applied this assay to effluents including municipal wastewater, treated wastewater, hospital wastewater, water from industrial processes. A part of our studies focused on performances of wastewater treatment plant (WWT). Assessing the quality of the WWTs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defines by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect present in the wastewater. The evolution should include measurement of the endocrine effect to allow the control of the treatment performance. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTP effluents showed 1) Daily variations of the thyroid effect in wastewater are linked to ecdysteroid concentrations and rainfall (XETA is sensitive to water quality variations), 2) in wastewater still contains thyroid active molecules, results from chemical analysis performed on the same samples indicated a correlation between the total micropollutant load, and the thyroid effect 3) A minor part of the thyroid effect removal occurs during and by decarboxification process. The major removal of the thyroid active molecule occurs during the nitrification step of the wastewater treatment.

MO190 The Xenopus Embryonic Thyroid Signalling Assay (XETA) for assessment of effluents contamination in thyroid active molecules.
The Xenopus Embryonic Thyroid Signalling Assay (XETA) was designed as a screening test to assess data to provide information on the potential of a test substance or a sample to alter the normal functions of the thyroid system. The XETA provides a rapid (<72h) way to measure the response of embryonic stage tadpoles to potential thyroid disrupting chemicals, allowing a efficient method for screening thyroid disruptors. XETA could provide an alternative to complex in vivo tests. It can be used for screening large number of molecules or testing environmental samples that couldn't be stored or sampled in large quanitities. OECD is currently validating this in vivo assay, the final stage of validation has been completed in 2017 and it is expected that the XETA may be approved as an OECD Test Guideline by 2019. OCDE validation focus on using the XETA to test pure chemicals but this test could be particularly useful for the hazard assessment of effluents. During the past 12 years we applied this assay to effluents including municipal wastewater, treated wastewater, hospital wastewater, water from industrial processes. A part of our studies focused on performances of wastewater treatment plant (WWT). Assessing the quality of the WWTs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defines by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect present in the wastewater. The evolution should include measurement of the endocrine effect to allow the control of the treatment performance. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTP effluents showed 1) Daily variations of the thyroid effect in wastewater are linked to ecdysteroid concentrations and rainfall (XETA is sensitive to water quality variations), 2) in wastewater still contains thyroid active molecules, results from chemical analysis performed on the same samples indicated a correlation between the total micropollutant load, and the thyroid effect 3) A minor part of the thyroid effect removal occurs during and by decarboxification process. The major removal of the thyroid active molecule occurs during the nitrification step of the wastewater treatment.

MO191 Advances on locomotion detection of Daphnia magna, Artemia franciscana and Paramecia caudatum
E.M. Salzer, V. Lioussia, X. Monforte Vila, D. Rünzler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Animal behavior is complex and multidimensional. Over the past decades researchers tried to quantify and qualify it, in order to understand and predict it. The advances in this field are so radical that they actually formed a new scientific domain called “computational ethology”. A major gap in this field is that most
studies focus on terrestrial and aerial species in comparison to aquatic organisms. A reason for this discrepancy is that compared to terrestrial species, additional technical challenges need to be overcome when studying aquatic species e.g. light refraction and reflection interferences at the air/water boundary, positioning of the light source and suitable body marking techniques. However, a deeper understanding of the movement patterns of small-sized aquatic invertebrates and planktonic organisms is urgently needed, as information on fish swimming behavior can be a powerful indicator for a wide range of environmental contaminants. Furthermore, changes in their locomotion could be used as an endpoint when studying neurotoxic effects. As a result, the aim of the present study was to improve the current tracking techniques of Daphnia magna, Artemia franciscana and Paramecium caudatum. In order to do so, custom-made, printable photosensitive tracking plates were developed. The tested organisms were placed in the costume-made plates and recorded under the microscope or in the observation chamber DanioVision. The horizontal and/or vertical tracking of the tested species were performed with the software EthoVision. The results of the present study showed that our custom-made plates had a higher tracking efficiency and a higher reproducibility score compared to the commercially available multi-well plates. Therefore, the easy to craft and cost-efficient plates can be implemented on behavioral and ecotoxicological studies on small-sized aquatic invertebrates and planktonic organisms in any lab with an access to a tracking system. Financial support from the City of Vienna project Ökotoxikologie (MA 23 - Project 15-06) is gratefully acknowledged.

MO192 Validation of the in silico prediction tool for toxicity of Algae by pharmaceuticals in environment
A. Hirose, M. Kurimoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraiishi, National Institute for Environmental Studies; H. Yamamoto, National Institute for Environmental Studies / Center for Health and Environmental Risk Research; N. Tatarazako, Ehime University / Environmental Risk; T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; N. Kobayashi, Y. Ikaraishi, T. Yamada, National Institute of Health Sciences
There are some concerns for environmental impacts of the pharmaceuticals due to the unintended environmental effects, which may be different from biological medicinal effects. Therefore, medical regulatory agencies require the assessment reports of environmental impacts by new drugs before marketing. It would be useful to predict the ecotoxicity of the new drug at the developmental stage, because the ecotoxicity studies are usually conducted at the final drug developmental stage just before submission. To validate the current in silico prediction tool, we evaluated the applicability for ecotoxicity prediction by the ECOASAR software, which includes toxicity prediction of industrial chemicals. In the last year, we evaluated the prediction performance of Daphnia magna reproduction and of the fish chronic toxicity. In this study, we evaluated prediction performance of the acute and chronic toxicity for algae. We used the ecotoxicity test data sets of about 100 pharmaceuticals. The EC50 values for the acute toxicity and the ChV for the chronic toxicity were compared with the prediction values estimated by the ECOSAR. The percentages of the pharmaceuticals of which the predictive values are different in less than one digit from the actual measured values are 43% and 44% for acute and for chronic toxicity, respectively. Overall applicability of toxicity prediction for algae was similar to that of toxicity for Daphnia magna or fish. In the case of Daphnia magna or fish, some antibiotics, anti-cancer, central nervous system agents with lower LogPow were underestimated. However, there is little dependency of LogPow in the case of Algae toxicity. Most of chemicals with aliphatic amines had tendency to be underestimated. This difference may reflect on the mode of actions between Daphnia/fish and Algae. In order to improve the predictability of the in silico ecotoxicity QSAR tool, more researches are needed on discovering the structure dependent toxicological profile of Algae would be needed. This work was supported by the Research on Regulatory Science of Pharmaceuticals and Medical Devices from Japan Agency for Medical Research and Development, AMED.

MO193 SeqAPASS to Evaluate Conservation of High-Throughput Screening Targets Across Multiple Levels of Sequence Similarity
Cell-based high-throughput screening (HTS) and computational technologies are being applied as tools for toxicity testing in the 21st century. The U.S. Environmental Protection Agency (EPA) embraced these technologies and created the ToxCast Program in 2007, which has served as a screening and prioritization tool for thousands of chemicals. The rapid and automated screening methods take advantage of hundreds of (primarily) mammalian-based HTS assays for identifying biological activity suggestive of potential toxic effects. The data can aid in identifying chemicals that are most likely to impact biological pathways that lead to adverse health effects. To realize the full potential of the ToxCast data for predicting adverse effects to both humans and wildlife, it is necessary to understand how broadly these data may plausibly be extrapolated across species. Therefore, the U.S. EPA Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was used to evaluate conservation of the 460 protein targets represented in the ToxCast assay suite. The SeqAPASS query sequence was selected based on the model organism used in the ToxCast assay (e.g., human, cattle, chimpanzee, guinea pig, rabbit, rat, mouse, pig, or sheep). Similarity of primary amino acid sequences and sequences from appropriate functional domains were compared across species to identify target across taxa. To demonstrate application of the SeqAPASS data for extrapolation of ToxCast targets, case studies were developed that focused on the extrapolation of targets being evaluated as part of the Endocrine Disruptor Screening Program, including the androgen receptor, enzymes involved in steroidogenesis, and proteins involved in lipid metabolism. These demonstrations demonstrate the utility of SeqAPASS for informing the extrapolation of HTS data and identification of model organisms likely to be suitable for follow-up or complementary in vivo toxicity tests. The contents of this abstract neither constitute nor reflect official US EPA policy.

MO194 In silico site-directed mutagenesis informs species-specific predictions of chemical susceptibility derived from the Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool
The Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was developed to address needs for rapid, cost effective methods of species extrapolation of chemical susceptibility. Specifically, the SeqAPASS tool compares the primary sequence (Level 1), functional domain sequence (Level 2), or individual amino acid residues depending on the particular target protein of a chemical in a known sensitive species to sequences of other species and calculates sequence similarity metrics to predict potential cross-species chemical susceptibility. Level 3 analyses offer the greatest resolution for extrapolation of chemical susceptibility across specific species, but uncertainties into the role of specific amino acid substitutions at key positions of proteins and whether they affect interaction with chemicals made manual interpretation of Level 3 analyses time consuming and potentially inconsistent. Therefore, this study used in silico site-directed mutagenesis coupled with docking simulations of computational models for acetylcholinesterase (AChE) and acetylcholine receptor (ECr) to investigate how specific amino acid substitutions impact protein-chemical interaction. This study found that substitutions in identities of key amino acids cause no change in chemical interaction with a protein if residues share the same side chain functional properties and have comparable molecular dimensions, while differences in side chain functional properties or molecular dimensions can reduce protein-chemical interaction. These findings were considered in the development of automated Level 3 analyses and enabled automatically generated species-specific predictions of chemical susceptibility. These predictions were shown to agree with Level 1 and 2 predictions of AChE and ECr for more than 90% of investigated species, but also identified dramatic species-specific differences in chemical susceptibility that align with results from standard toxicity tests. The consistency of automated predictions of susceptibility across Levels 1, 2 and 3 and agreement with results of standard toxicity tests provides a compelling line-of-evidence for use of SeqAPASS in improving species-specific chemical susceptibility predictions across broad taxonomic groups applicable to addressing challenges in species extrapolation for human and ecological hazard assessment. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO195 Survival and Teratogenic Evaluation of 91 compounds with environmental impact.
S. Calzolari, ZeClinics
ZeClinics (www.zeclinics.com) is a biotech company interested in developing efficient and reliable zebrafish screening tests to predict compound toxicity in aquatic species and organ related toxicity. The major advantage of using zebrafish is that they offer a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of end phenotypes, analysis procedure, etc. -- that can be applied by all the zebrafish toxicity community (SOP like protocols) and, eventually, to become the base for regulatory approval for the standardized test. In this study, we have performed a Developmental Toxicity Test on the NTP 91 compound list. For each compound, 20 zebrafish embryos were exposed to the compound at different concentrations (Log3 dose/response curve: 100 μM, 33 μM, 10 M, 3.3 μM and 1 μM) for a single biological replicate. Experiments were performed in chorionated embryos from 3 hpf to 96 hpf. Endpoints were analysed at 24, 48 and 96 hpf. Quantified phenotypes include mortality rate and teratogenic endpoints such as body deformity, scoliosis, pigmentation, heart edema and motor behaviour. It is important to note that the majority of the provided compounds were already dissolved in DMSO at 10 mM. This fact limited the range of maximum concentrations tested, which might have impacted in a lower-than-expected correlation between zebrafish and human data. In fact, 49/91 compounds did not
show any toxic phenotype at the maximum evaluated concentration. On the other hand, 39 displayed mortality and teratogenic phenotypes. Among them, the most toxic compounds were Saytex CP-2000, 4,4'-hexafluorodiisopropylidene diphenol, 3-lodo-2-propynyl n-butylcarbamate, diethylstilbestrol, hexachlorophene, methylmercuric chloride, rotenone and tetraethylthiuram disulfide.

MO196

MPA - an alternative for the standard procedure of Ames Test
J. Rossetto Martins Zwart, School of Technology, UNICAMP; D.A. Morales, State University of Campinas / Faculty of Technology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; G. Umbuzeiro, School of Technology, UNICAMP / LAEG

The Salmonella/microsome assay (Ames Test) is the most widely used mutagenicity test for evaluation of pure chemicals and environmental samples. There are several protocols available in the literature, including those that reduce the amount of sample needed for testing with liquid and agar media. There is a miniaturized version using liquid media called Microplate Fluctuation Protocol (MFP) that has been extensively used specially in Europe. It is has similar sensitivity with the standard Ames as well as other protocols and good performance in interlaboratory studies. However, the MFP has some disadvantages such as being difficult to apply with strains with low and high spontaneous mutation frequencies. Another miniaturized version of the Ames test is the microsuspension assay, which is 13 to 20 times more sensitive than the standard protocol. It is performed 5X concentrated bacteria and less sample and S9 mixture but still uses conventional petri dishes (90 x 15 mm). It has been extensively used for environmental samples testing, including in Effect Directed Analysis (EDA). The objective of this study was to miniaturize of the microsuspension Salmonella/microsome assay using agar microplates under the concept of the 3R principle. The conventional plates were replaced by plates with 12 micro wells. For validation of this miniaturization, we selected 13 known more or less potent mutagenic compounds. Six were tested only without metabolic activation (S9) and the other 7 were tested only with S9 using three Salmonella tester strains that were selected based on their different spontaneous reversion frequencies (low, medium and high). The miniaturization procedure conditions were made as similar as possible to the Microsuspension protocol, using the same testing design, metabolic activation, and data interpretation. Each test was conducted in parallel. MPA and Microsuspension protocols showed 100% agreement, qualitatively and quantitatively. MPA is less laborious, uses less sample, materials, and reagents reducing overall costs. The amount of sample required for testing is at least 10 times less in comparison with the standard Ames assay. We conclude that MPA is a promising tool and could be used in substitution of the standard Ames procedure especially in situations where sample quantity is a limitation such as impurities, drugs in development and low concentration samples. In environmental and environmental monitoring studies.

MO197

SETAC Animal Alternatives Interest Group
A. Lilliencrap, NIVA Norwegian Institute for Water Research / Ecotoxicology

Bioavailability and realistic risk assessment of organic chemicals (P)

MO198

The necessity of OASIS bead and polyethersulfone membrane extraction for the Polar Organic Chemical Integrative Samplers (POCIS) calibration: a case study for alkyphenol monitoring in produced water
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Produced water (PW) is one of the largest discharges from the oil and gas industry and includes formation and injected water. It contains several toxic compounds such as polycyclic aromatic hydrocarbons (PAHs), alkylphenols (APs), heavy metals, etc. PW is usually treated on the plat- form by adsorption in a Pilot scale (POCIS). The pilot test demonstrated that there was a lag phase in uptake for APs, and that APs with log Kow > 5 were accumulated more efficiently in the PES membranes. The extraction of both the PES membranes and the OASIS beads is thus needed when working with the POCIS in order to capture low contaminant concentrations and allow the detection of the less hydrophobic APs. This can be very useful in environmental applications because it may justify the use of only one passive sampler to monitor a wider range of contaminants.

MO199

In situ passive sampling methods to measure freely dissolved concentration of PAHs in contaminated soil: comparison with ex situ measurements and evaluation over one year
N. Bartolome, Agroscope; T. Bucheli, Agroscope / Reckenholz-Tänikon Research Station / ARS; E. Eek, NIVA Norwegian Institute for Water Research / Ecotoxicology; J. Hilber, Agroscope / Environmental Analytics; R. Schulin, ETH Zurich / Department of Environmental System Science; P. Mayer, Technical University of Denmark / Department of Environmental Engineering; T. Bankeli, Agroscope ART / Environmental Analytics

Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments polluted with hydrocarbon organic contaminants (HOC). Over the past decade, researchers have successfully developed various passive sampling (PS) methods to assess the freely dissolved concentrations of HOC in soil pore water or suspensions (Cfree). The Cfree play a key role for environmental fate and toxic effects of these compounds. Field conditions such as temperature, ionic strength or soil water content may influence the distribution of HOC between soil water and air. The aim is to evaluate the potential of the in situ PS method for providing promising results to measure Cfree in the pore water of sediments, there is still very little information on the suitability of these methods for their application to soils, particularly under unsaturated water conditions. Here, we present the results of in situ PS concentrations of polycyclic aromatic hydrocarbons (PAHs) in six different field soils after 12 months of exposure. The field soils were located in green parks and hence permanently water-saturated, while the other three were located in grassland and thus not saturated. Low density polyethylene (LDPE) was used as PS method. The samplers were deployed in situ covering a depth of 20 cm below the soil surface. Concentrations were assessed at all sites after six, nine and twelve months of exposure. For comparison, soil samples from the same locations were also taken using a conventional ex situ soil suspension method. The main objectives of this study were (1) to compare the measurements obtained with the two sampling methods, (2) to assess the influence of soil water saturation of the measurements (unsaturated versus saturated), and (3) to determine the role of seasonal variation (temperature and precipitation variation) and exposure time on the results of the in situ PS method. To our knowledge, this is the first experiment where PS methods were used to determine PAH concentrations in the pore water of sediments under field conditions in situ and to study the impact of soil water saturation. This study will help to find out whether in situ PS methods in soils are a tool to be potentially included in risk assessment and legislation.

MO200

Bioaccumulation of native and spiked p,p′-DDE by Eisenia andrei in γ-stabilized and non-stabilized soils
I. Hilber, Agroscope / Environmental Analytics; R. Bucheli, Agroscope ART / Environmental Analytics; T. Bankeli, Agroscope ART / Environmental Analytics

γ-stabilization of soil organic matter (SOM) can enhance bioavailability of organochlorine pesticides (OCPs) during the preparation of soil samples for bioaccumulation tests. γ-Stabilization is used to cohere the OCPs in the soil matrix, to facilitate their extraction during the analysis, and to reduce their volatilization during storage. Several studies have demonstrated the potential of γ-stabilization to increase the bioavailability of OCPs and the uptake of OCPs by soil organisms. However, little is known about the effect of γ-stabilization on the uptake of OCPs by soil organisms. In this study, we investigated the effect of γ-stabilization on the bioavailability of OCPs and the uptake of OCPs by soil organisms. The results of this study will help to improve the understanding of the bioavailability of OCPs and the uptake of OCPs by soil organisms. The results of this study will help to improve the understanding of the bioavailability of OCPs and the uptake of OCPs by soil organisms.
non-sterile and sterile soils. Sterilization appeared to increase uptake rates and reduce the influence of p-p 'DDE-soil contact time on bioaccumulation. These effects might be attributed to the effects of γ-irradiation on SOM chemistry alone or in combination with earthworms. Following our findings, γ-irradiation can be recommended as a relatively non-destructive method that is not expected to significantly affect risk assessment of bioaccumulative chemicals. However, in mechanistic studies the possible side-effects brought about by γ-irradiation should be taken into consideration.

**MO201** Dissipation in soil and bioavailability to earthworms of two fungicides: comparison of laboratory and field experiments
S. Alonso-Solé, G. Delarue, J. Amossé, Noé Bart, Xia. Xia, School of Environment, Beijing Normal University; X. Xiong, School of Environment, Beijing Normal University; X. Guo, School of Environment, Beijing Normal University; Y. Zhai, School of Environment, Beijing Normal University

The fungicide fate in soil is currently studied through laboratory experiments, using homogenized soil and controlled incubation conditions. However, the representativeness of such experiments is questionable regarding to field conditions, i.e., soil heterogeneity, vegetation cover and climatic variations. Upon the few studies performed simultaneously under field and laboratory, the fungicide persistence and/or sorption on soil were evaluated as different; thus bioavailability could also be different. This study aimed at comparing the dissipation and the bioavailability of dimethylchlor and epoxiconazole (two fungicides used in the commercial formulation of Swing Gold®) in a loamy soil and in earthworms under laboratory and field conditions. Field experiments were conducted in a meadow located in Versailles (France) on 100 m² plots. The field soil and earthworms were regularly sampled after the treatment, over one year (April to April). Laboratory experiments were performed by mixing the fungicide solution with surface soil issued from the same field, and incubated in dark, at 15°C and constant humidity. In both cases, four replicates were performed using the recommended Swing Gold® dose, extra doses adapted to observe ecotoxicological effects and controls. The dimethylchlor and epoxiconazole concentrations in soil were determined by an exhaustive extraction method and, to evaluate their availability, with a mild method engaging hydroxypyrol-β-cyclodextrin. At the same time, the bioavailability of the fungicides was evaluated by determining their concentrations in exposed earthworms Apoportrectodea icterica and Aporrectodes caliginosa. All analyses were performed by UHPLC-MS/MS. Under field conditions and five days after pesticide application, only 10% to 45% of pesticide residues were measured in topsoil, with high heterogeneity between replicates. After one month, the concentrations in soil increased, probably due to a plant-soil transfer. By contrast, applied dose was observed at initial time under laboratory conditions. For later dates and in both cases, dissipation was observed. The available fraction showed homogeneous rates under field conditions, whereas it was highly heterogeneous in the laboratory. The ratio of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

**MO202** Experimental assessment of specific plant uptake factor of 1,2,4-triazole with different concentrations in wheat
R. Faraldo-Alonso, Innovative Environmental Services (IES) Ltd / Plant Metabolism; E. Esteban, Universidad Autónoma de Madrid / Agricultural Chemistry and Food Science; S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; D. Williams, Innovative Environmental Services IES Ltd / Plant Metabolism; S. Nélieu, G. Delarue, J. Amossé, Innovative Environmental Services IES Ltd / Plant Metabolism

Environmentally significant risk assessment decisions in EU for Plant Protection Products (PPP) regulation are based on information obtained from Environmental Fate models. Such models (e.g., FOCUS PEARL and PEMTO) attempt to quantify the potential for movement of pesticides and their metabolites to ground water and require data derived from experimental studies based on validated guidelines. Currently, guidelines detailing degradation and absorption processes of pesticides and their metabolites in soil do not accurately account for uptake by plants via root system, with plant uptake compartments only being given a default value. As plant uptake affects the environmental availability of these substances, accurately quantifying how this affects their potential risk is of great importance. The plant uptake describes the process of translocation of dissolved compounds in the soil pore water to the plant via the transpiration stream and it can be described using the plant uptake factor (PUF) – uptake into shoots and roots – or the transpiration stream concentration factor (TSCF) – uptake into shoots. Recent work by the ECPA/IVA Working Group “Plant Uptake Factor” has produced a draft working protocol designed to experimentally determine the uptake of active substances as well as metabolites via planting root system. The purpose of the present study was to obtain reliable substance-specific plant uptake data – with different root zone exposure concentrations – using the study design proposed in draft working protocol. The set-up of the experiment was chosen to enable optimal growth of the test plants – wheat seedlings – grown in a hydroponic system under controlled environmental conditions. At BBCH 13 (3 leaves unfolded) “C6-labeled 1,2,4-triazole was spiked into the hydroponic solution at different concentrations and the plant root system was exposed for 8 days. Mass balance – calculated from the sum of radioactivity found in the hydroponic solution, root wash plus roots and shoot tissue – and transpiration – calculated gravimetrically – were determined. The experimental data obtained were used to calculate uptake parameters – PUF and TSCF – according to the formulas mentioned in the literature.

**MO203** LFER Models for Partition Coefficients of Environmental Concern
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Traditionally, partition coefficients of environmental concern, including bioconcentration factors (BCF) and soil or sediment sorption coefficients, are predicted using approaches based on simple linear relationships with the octanol/water partition coefficient (Kow). Recently, more sophisticated prediction models have been developed and applied, including LFER approaches. Such approaches allow distinguishing between separate sorption and desorption kinetics. However, this requires data on distinct partitioning processes, which are rather scarce. For theoretical models without the need for additional experiments, the partition coefficients for these separate processes have to be estimated. While these coefficients basically could be roughly estimated from Kow, the more sophisticated LFER equations, known as Abraham models, are preferred for such predictions.

The and the respective partition coefficients were estimated using the study design proposed in draft working protocol. The partition coefficients of neutral organic compounds between water and immobilised artificial membranes (IAM), liposomes (membrane lipids), triolein (storage lipids), and sediment. The development of the models was based on new experimental data, as determined by the authors. Possible sources of the required Abraham parameters are examined, compared and discussed. Particular attention is given to the transferability domain of the models. Acknowledgment: This study was financially supported by the European Union 7th Framework Programme SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.

**MO204** Influence of grain size on the bioavailability and bioaccumulation of sediment-associated cypermethrin to benthic invertebrates
H. Li, J. You, Jinan University / School of Environment

Sediment particle-size distribution is an important factor influencing the bioavailability and toxicity of hydrophobic organic contaminants (HOCs) in sediment. Cypermethrin, a pyrethroid, was used as an example in the current study to assess the effect of particle size on the sorption kinetics of cypermethrin and bioaccumulation potential of sediment-associated HOCs. Bioaccumulation test with oligochaete Lumbricus variegatus and two chemical techniques, namely Tenax extraction and matrix-solid phase microextraction (SPME) were applied in the current study. A field sediment was collected and wet sieved to obtain five particle-size fractions: i.e., <20 µm, 20-63 µm, 63-180 µm, 180-500 µm and >500 µm. The respective particle-size fractions were 8.92%, 10.6%, 14.7%, 28.6% and 0.31%. The results of sediment characterization showed that the material, composition, surface area and adsorption capacity were significant different among sediments with different particle size, and adsorption capacity increased with decreasing particle size. In addition, the desorption rates of cypermethrin measured by Tenax extraction decreased with decreasing particle size, which supported the hypothesis that HOCs bound stronger to fine sediment particles than coarse sediment. The different desorption rates of cypermethrin in different particle-size sediments may influence the freely dissolved concentrations in sediment porewater, and subsequently bioaccumulation potential and toxicity.

**MO205** Effect of suspended particle on polycyclic aromatic hydrocarbon (PAH) bioaccumulation by zebrafish (Danio rerio)
Y. Zhai, X. Xia, School of Environment, Beijing Normal University; X. Xiong, School of Environment, Beijing Normal University; L. X. xiao, School of Environment, Beijing Normal University; Y. Zhai, School of Environment, Beijing Normal University

Hydrophobic organic compounds (HOCs) tend to be associated with suspended particles in surface aquatic systems, however, the bioavailability of HOCs on suspended particles to fish is not well understood. In this study, a passive dosing device was used to control the freely dissolved concentration of polycyclic aromatic hydrocarbons (PAHs) including fluoranthene and pyrene, and the influence of particle-associated PAHs on their bioaccumulation by zebrafish was investigated. Results showed that the body burdens of PAHs in the zebrafish including the digestive tract (without the head part) were higher than that in the zebrafish excluding digestive tract at the beginning of PAH bioaccumulation, and lower after two day bioaccumulation. The difference may be caused by the effect of PAHs associated with particles in the digestive tract. When PAHs on suspended particles were ingested and they were mainly stored in the digestive tract of zebrafish in the beginning of the bioaccumulation; because the bioaccumulation factors of PAHs in zebrafish were higher than the partition coefficients of PAHs in suspended particles, the concentrations of PAHs in zebrafish excluding digestive tract were higher than that in zebrafish including digestive tract in the later bioaccumulation
process. Suspended particles promoted the uptake and elimination rate constants of PAHs to zebrafish body excluding head and digestive tracts. The uptake rate constants with 0.5 g/L suspended particle were approximately twice that without suspended particles, and the body burden in zebrafish increased by 16.4% - 109.3% for pyrene and 21.8% - 490.4% for fluoranthene during the first 8-d exposure. The findings from this study indicate that PAHs on suspended particles are partly bioavailable to zebrafish and particle ingestion is an important route in PAH bioaccumulation. Therefore, it is important to consider the bioavailability of HOCs on suspended particles to improve ecological risk assessment.

MO206 Methods for Deriving Site-Specific Relative Bioavailability Factors from Ambient Bioavailability

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The U.S. Department of Defense is responsible for the environmental restoration of properties that were formerly used for firearm training ranges. Remnants of spent shell casings are determined to be a source of polycyclic aromatic hydrocarbons (PAHs) at these sites based on results from surface soil analyses and historical information demonstrating that spent shells were commonly prepared using coal tar pitch as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone mixture of the spent shells reduces the oral bioavailability of PAHs compared to that seen in animal studies using pure benzo(a)pyrene in solvents added to diets. To test this hypothesis, soil samples were collected from the two sites to provide a range of PAH concentrations. Female B6C3F1 mice were fed diets amended with soil or soil extracts at a rate of 5% in the diet for 14 days. For benzo(a)pyrene (BaP), the fraction of total dose excreted in the urine (FUE) was determined for the soil- and soil extract-amended treatment groups. The Relative Bioavailability Factor (RBAF) is the ratio of the FUE in animals treated with soil over the FUEs of animals treated with extracts of soil. Because each soil sample was tested in four cages of mice (two for soil and two for soil extract), there are different ways of computing the RBAF of each soil and the grand RBAF for the site. Pairwise RBAFs can be determined and averaged, but the more robust way to determine a site-wide RBAF from multiple sample points is to determine a linear regression of the bioavailability ratios versus daily dosing rates. The FUEs produced coefficients of determination (r²) that were greater than 0.83 and typically greater than 0.95, showing that the rate of BaP metabolite excretion was directly proportional to the daily dose rate of BaP. RBAFs were determined using Monte Carlo simulations to calculate the 95% upper confidence limit on the ratio of the soil and soil extract FUEs. The site-wide RBAF was equal to 14% for BaP. Part of the RBAF will be compared to the RBAF resulting from the regression approach, and the regulatory precedent for the regression approach will be presented.

MO207 Accurate determination of adsorption coefficients for low adsorbing compounds - from experiment to result evaluation

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The determination of adsorption coefficients is a critical key parameter for the assessment of the leaching properties of low adsorbing compound’s through the vertical soil profile. In case of expected low adsorption of a chemical compound, several experimental preconditions need to be considered to enable accurate adsorption parameter determinations: (1) An initial soil/solution ratio of 1/1 and (2) the liquid phase needs to be removed as completely as possible from the soil phase upon completion of the equilibrium. An experimental approach was developed and optimized allowing the efficient separation of the soil and liquid phase by centrifugation through the soil itself and a filter/fit system. Determination of distribution coefficients is done based on the direct method, hence extraction and analysis of the soil phase as well. Apart from the optimized experimental approach the data evaluation is addressed. This includes the elimination of any apparent sources of experimental random errors e.g. by suitable outlier tests. Possible systematic errors have been addressed by the experimental design/data evaluation itself leading always to an underestimation of obtained adsorption parameters. The data evaluation includes the calculation of adsorption coefficients (e.g. Kf) and of p-values with p=Kf* (msoil/msolution); note: msoil/msolution after phase separation. If p < 0.3, reliability of obtained Kf values is given according to “EFS, 2017. Technical report on the outcome of the pesticides peer review meeting on the OECD 106 evaluators checklist”. If p < 0.3, additional considerations are necessary, e.g. suitable statistical tests, in order to evaluate data quality and to demonstrate significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95 % confidence intervals of Kf and Kfoc from isotherms are derived. By reference to examples, data evaluation for cases with p values > and < 0.3 are presented indicating opportunities of that approach.

MO208 Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomonas sp. strain ADP

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Atrazine on herbicide used to control grassy and broadleaf weeds in sugarcane, wheat, conifers, sorghum and corn crops. Although since 1992 in European Union Countries it has been banned owing to its toxicological effects, it remains one of the most consumed worldwide pesticide with annual consumption of about 70,000–90,000 tons. Atrazine removal from the environment depends on abiotic (photolysis and hydrolysis) and above all biotic degradation. The latter can be significantly affected by the herbicide bioavailability. The behavioral reactions of bacteria are rarely included in the biological assessment of contaminants ecotoxicity. For this reason, we investigated the swimming behaviour and tactic response of the motile atrazine-mineralizing bacterium Pseudomonas sp. strain ADP to different concentrations of the herbicide in a laboratory experiment. The tactic response was assessed by a chemical-in-capillarity method and an inverted capillary assay for the repellent reaction in association with microscopic observations. The swimming behaviour was evaluated by a computer motion analysis software (CellTrack). We observed attraction responses at relatively high concentrations of the chemical, including at water-saturating concentrations. We also noticed that atrazine can elicit a negative tactic response at low concentrations. We also observed that the swimming patterns of Pseudomonas sp. strain ADP was delayed by 28 days of the data was non-parametric, it was increasing using non-parametric. The physiological relevance of the chemiotaxonomy to pollutants lies in the fact that these compounds serve as carbon and energy sources. The overall results suggest that we can use the behavioral responses of motile bacteria as a useful method to estimate pollutant toxicity at ecologically relevant concentrations. The bacteria behavioral assay on pollutants can be an alternative or complementary method to the current ones, because it is a high sensitivity and visualization method.

MO209 The influence of biochar on the toxic effects of imidacloprid to the lifecycle parameters of Eisenia fetida

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Imidacloprid is an organic active ingredient for various insecticides used to kill a number of biting and sucking insect pests. As a soil amendment, it can enhance sorption and reduce the bioavailability of organic toxicants. Earthworms are important soil promoters and provide various benefits to plants and they are too sensitive to various pollutants, thus they are relevant indicators of environmental change. The current study aimed to assess if biochar has the ability to decrease the effects of the toxicity of the agro-insecticide imidacloprid (IMID) to earthworms. Coccoons laid by earthworms that had never been in contact with any toxicant were exposed to biochar-amended and non-amended aqueous solutions of IMID for a period of 26 days. The data was non-parametric, it was increasing using non-parametric. Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to p < 0.05. The results revealed that the effects of IMID on hatching success were only significant at the highest concentration of 400 mg/L. These findings indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such E. fetida from hatching. This suggests that IMID could lead to decrease population growth rate or complete population collapse in such invertebrates.

MO210 Chlordecone elimination kinetics in ewes

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Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 against several pests in Europe. This pesticide is regularly used in France. For its high persistence in the soils (concentrations are above 1 mg.kg⁻¹ of dry matter), the herbicide is directly contaminated by involuntary soil ingestion. Previous studies showed a CLD absorption of 100% in goats and its metabolization to chlordecone metabolites were analyzed in urines and feces (for the 1 mg/kg BW dose) at ANSES – Hélène Carter. We observed that the effects of IMID on hatching success were only significant at the highest concentration of 400 mg/L. These findings indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such E. fetida from hatching. This suggests that IMID could lead to decrease population growth rate or complete population collapse in such invertebrates.
values were not significantly different (P > 0.05). Thus, it was possible to conclude that CLD toxicokinetic of CLD in ewe is linear. In urines, CLD and conjugated CLDHO were quantified. By comparing the two way of CLD excretion, feces appears to be the principal route of CLD elimination. Almost 60% of the administrated dose was found in feces and only 2% was found in urines. To conclude, the elimination of CLD in serum of ewe is dose-dependent with the dose. In consequence, the different results obtained in CLD HO in ruminant can be extrapolated for different levels of exposure in the range of 0-1 mg/kg BW. This study reveals the CLD metabolism in ewes which was never shown before. The principal route of CLD elimination is via the feces. These results clearly indicate the CLD elimination kinetic in ruminants and will help to decontaminate exposed animals in the French West Indies.

MO211
Development and validation of QuEChERS extraction methods with or without enzymatic pretreatment to analyze chlordecone and its metabolites by HPLC-MS/MS in urine and feces of ewes

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Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 in the French West Indies to fight against the banana black weevil. It is known to increase the risk of prostate cancer and affect development of the foetus and after birth. Nowadays, this pesticide is no longer used but, because of its high persistence, it remains in soil. Consequently, farm animals can be contaminated by soil ingestion and this is key issue for French West Indies breeding. Thus, this work tends to collect data about the CLD elimination in ewe so as to propose a decontamination strategy. CLD is mainly eliminated in feces and low amounts of CLD can be found in urines. CLD can be metabolized into chlordecol (CLDHO) in human, pigs and gerbils rodents. Then CLD and CLDHO can be conjugated by the glucuronoltransferase. In feces, CLDHO was found but no conjugated metabolites were present. In urines, no conjugated metabolites were found although the authors thought they would. Actually, no information about the CLD elimination in ewe is available. These findings results were based on a former extraction method developed in 1990 to analyze CLD and its metabolites in urines and feces. The extraction was performed by liquid-liquid extraction. Quantification of the conjugated metabolites was calculated by difference between a sample with and without enzymatic treatment. The analysis was then performed by gas chromatography hyphenated with mass spectrometry. In order to have an update and a more sensitive method, a new development was carried out with this work. The extraction was based on the QuEChERS methodology which is more and more used in the pesticides field. As no conjugated standards were available an update enzymatic pretreatment was set up. The analysis method was performed by liquid chromatography with tandem mass spectrometry using isotopic dilution given a reliable method. The methods were then validated according to the French standard NF V03-110 and the European Union guidelines. At the outcome of the method development the CLD and its metabolites were successfully extracted and measured with the OECD 317. According to the literature, CLD and CLDHO were present in ewe feces. In urines, CLD and conjugated CLDHO were quantified. These results highlighted a better sensitivity of the new method and allow proving the CLD metabolism in ruminants which was never made before.

MO212
Organic Contaminants in High Mountain Areas: Where and When to find them??

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Semivolatile organic contaminants (SOC) are well known to undergo atmospheric long-range transport and enrich in remote high mountain ecosystems. To predict the risk for high mountain ecosystems it is necessary to have knowledge of the present concentration of SOC and their bioavailability. The calculation of the chemical concentrations of SOC differs vastly in magnitude and spatial distribution as OECD 317 and PCD/PDD/Fs to plants and invertebrates has been studied: BCF in several plants and in earthworm has been measured and different methods have been proposed to determine the chemical concentrations in the matrices analyzed, honey bee colonies health could be compromised. Assessing pesticide concentration in these three different apicultural matrices at the same time is a useful tool to understand the magnitude of honey colonies exposure to toxic compounds, which is one of the main causes of the progressive decline in bee colonies around the world.

MO214
Adaptation requirements for the use of measured BCF for a realistic risk assessment of organic chemicals.

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One of the main factors in the secondary poisoning risk assessment is the bioavailability of potentially hazardous organic chemicals, especially in the case of soil contaminated with persistent organic pollutants. In the context of the TROPHÉ project, the transfer of PCBs and PCCD/Fs to plants and invertebrates has been studied: BCF in several plants and in earthworm has been measured and different methods have been proposed. The approach drawn is that there is no match between available guidelines to produce measured BCF in terrestrial organisms and the BCF needed with the REACH regulation guidance for ecological risk assessment. This guidance states that the exposure concentration for terrestrial predators can be calculated in taking into account the quantity of soil contained in the earthworms guts and the contaminant fraction measured in its flesh. This fraction calculated in the product of the contaminant concentration in interstitial water and the BCF. But this BCF, relatable to interstitial water, is not comparable with BCF measured with available guideline as OECD 317 – Bioaccumulation in Terrestrial Oligochaetes, relatable to total concentration in soil. Data obtained in the context of the TROPHÉ project allow for the comparison between PCB-PCDD/Fs, PCB-earthworm measured with the OECD 317 guideline and PCB-PCDD/Fs/PCDFearthworm extrapolated from the Kow of the substance. It was also possible to illustrate the impact of these differences on the results of the secondary poisoning exposure modeled concentrations. A screening on the ECHA registration site also provides an approximation of the number of registered substances that have a BCFearthworm measured with guideline relatable to total concentration in soil and therefore unusable as such in the recommended methodology according to REACH.

MO215
Assessing risks from PBT substances in surface waters: possible alternatives to biota monitoring?

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The Water Framework Directive (WFD) requires waterbodies to be at ‘good status’ as compared to a ‘background’ chemical status by meeting Environmental Quality Standards (EQSs). Normally, these standards are expressed as critical concentrations in the flesh of aquatic biota (biota EQSs) which have been developed for some chemicals that are persistent, bioaccumulative and toxic (PBT) with the aim of protecting predators and humans from chemical exposure via the foodchain. Biota standards are now set for 11 PBT substances or groups of substances, requiring Members States to set up monitoring regimes to assess the risks to surface waters. Biomonitoring (fish or invertebrates, depending on the substance of interest) is the most relevant sampling matrix but it is destructive, and suitable biota cannot always be found where sampling is required. As a result, the coverage offered by biota sampling programmes is much less extensive than the number of chemicals that are PBT. A toolbox of approaches has been proposed to assess risk to surface waters. Most of these techniques take into account the risk of secondary poisoning, which is assumed to be related to input of pollutants; however, no systematic approach has currently been developed to assess and prioritize such input. Assessing risks from PBT substances in surface waters: possible alternatives to biota monitoring?
sampling of water. This means that extrapolation to unsampled waterbodies is needed but this is highly uncertain, so national risk assessments are difficult to achieve. This study explores alternative matrices to biota sampling, focussing on sampling of (a) whole water and (b) the dissolved fraction estimated from passive sampling. We describe studies in which chemical analyses of whole water and passive samplers for a range of PBT substances are compared with water thresholds but which are more representative of the bioavailable fraction. Biological risk assessments are compared with those made using biota samples taken from the same locations in UK surface waters. The utility of these matrices as possible alternatives to biota monitoring is examined, and their implications for future risk assessment is discussed.

MO216 Risk Associated with Alternative Cleaning Method for Carrot P. Abar, Federal University of Technology Owerrri / Department of Biological Sciences; L.A. Adjeroh, C.O. Ezea, Federal University of Technology Owerrri / Biology; A.C. Udebuani, Federal University of Technology / Department of Biotechnology
ABSTRACT Risk Associated with Alternative Cleaning Method for Carrot
Introduction Carrot is a nutritional root vegetable which is loaded with beta carotene, a precursor of vitamin A. It is necessary to wash carrots in order to remove soil and other foreign materials before eating either raw or in processed form (Moos et al., 2002). It is common practice nowadays to soak carrot in detergent solution before washing to achieve better cleaning. Some components of detergent are toxic (HERA, 2013; Chukwukwu et al., 2015). The aim of this study is to evaluate the detergent residue accumulated in carrot exposed to detergent. Methodology The first stage involved distribution of questionnaires to determine the popularity of the use of this chemical substance in washing carrot before selling to consumers. The second stage involved soaking 2 kg of fresh carrots in five increasing concentrations of Detergents 1 and Detergent 2. The carrots were soaked for 20, 40 and 60 minutes, after which they were grounded and analyzed using the titrimetric method described by IPAN (2005). Results a. 64.29% of the respondents agreed to the use of detergent in soaking before washing. 25.14% do not use detergent in washing their carrots before selling to consumers while 10.57% were indifferent. Anionic Surfactant Residue in Exposed Carrots There was a concentration and time dependent increase (P < 0.001) in the percentage anionic surfactant in the exposed carrots Figure 1: Anionic Surfactant present as Residue in Carrot Washed with Detergent. c. Percentage Cationic Surfactant Residue in Exposed Carrot The percentage cationic surfactants residue increased with concentration and length of exposure. Figure 2: Percentage Cationic Surfactant Residue in Exposed Carrot. Figure 29: Quantity of Detergent Residue in Exposed Carrot. Conclusion The percentage of residual amount of detergent in the exposed carrot raises a public health concern as this food item is daily consumed by unsuspecting public.

MO218 Uncertainty concepts and misconceptions for landscape scale risk assessment P. Thorbek, Syngenta / Environmental Safety; M. Hamer, Syngenta / Environmental Safety; K.Z. Travis, Syngenta / Product Safety; A. Raybould, Syngenta
In Europe there appears to be two opposing views on the future of ecological risk assessment of pesticides. One aims to improve ecological realism and move towards landscape scale risk assessments whereas the other aims to simplify and focus on lower tier exposure and effect assessment. To some extent this dichotomy is based on differences in uncertainty perception. Thus, one camp focuses on what we here term “in-study uncertainty” and therefore holds that higher tiers are more uncertain than lower tiers. The other camp focuses on what we term “extrapolation uncertainty” and therefore holds that higher tiers are closer to real uses in real landscapes and therefore less uncertain than lower tiers. A purely statistical view of uncertainty often assumes different sources of uncertainty are independent and when this is combined with a focus on high percentiles, uncertainty measures quickly multiply up and inflates the perceived uncertainty. However, biological systems are controlled by a range of feedback and regulating mechanisms aimed at maintaining homeostasis and ecosystems normally have at least some redundancy; therefore high uncertainties are typically not multiplicative. Further compounding the different views of uncertainty, is the natural variability in real landscapes. One view holds that the effects of pesticides should be isolated from the natural variability to describe the “true” effect and, since this is difficult, holds that landscape scale risk assessments increases uncertainty. The other view holds that the effect of pesticides should be related to the natural variability and hence landscape scale risk assessments reduces uncertainty. Here we review the different components of uncertainty, what role they play in landscape scale risk assessment and we propose a way forwards for making uncertainty analysis more useful for decision making.

MO219 Concept for a regional geospatial landscape analyses to predict site specific vegetation covers A. Toschi, Research Institute Gaiaia; G. Lennertz, Research Institute Gaia / gaia - Research Institute for Ecosystem Analysis and Assessment; T. Schaud, Bayer Ag / Environmental Modelling; T. Preuss, Bayer Ag / Environmental Safety
The spatial pattern of plant communities in the agricultural landscape is depending on land management and the site specific environmental and soil conditions. In vegetation science the composition of plant species and their abundances in dependence on these factors are extensively described. This project follows the hypothesis that if the decisive environmental and soil parameters (soil type, soil texture, nutrient etc.) are available it is possible to predict the vegetation cover and subsequently the composition of plant species on this site. As a starting point the main grassland types of North Rhine-Westphalia and Mecklenburg-Western Pomerania (Germany) were considered and data for vegetation communities, plant species and their frequency and abundance were imported in a PostGIS database. Additionally geospatial data (shapes of grasslands, soil types etc.) were imported in this spatial database. As a second step a matrix of combinations of soil and environmental parameters was built and calibrated in ‘if-then’ steps with the main preferences of the different vegetation communities. The poster show first prediction results and discuss pro and cons of the concept as well as possible refinements in the future. The supply of data originated from these predictions could be helpful in many facets of risk assessment on a regional scale.

MO220 B-Rice: bird focal species identification in rice paddies A. Caffi, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; F. Marchetti, ICPS / Public Health; F. Galimberti, A. Riva, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; L. Bani, V. Oriozi, Università degli Studi Milano Bicocca / Dipartimento di Scienze dell’Ambiente e della Terra; S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health
Pesticide registration in EU (Reg. 1107/2009 EC) requires appropriate risk assessment for non-target organisms including birds. The European Food Safety Authority developed a Guidance Document (GD) to conduct the risk assessment considering a series of exposure scenarios from a combination of crops and growth stages, selecting relevant species at the lower steps of a tiered approach. The actual GD doesn’t include scenarios for pesticide applications on rice; nowadays bird risk assessment is generally performed considering rice as the other cereals. Rice paddies are exposed to pesticides by: 1) direct application; 2) spraying from neighbouring crops; 3) drift from aerial applications; 4) run off from livestock pastures and 5) drift from biocides used in non-pesticidal or non-chemical control methods. The methodological challenges are related to the variety of scenarios, the lack of data related to exposure scenarios, the importance of risk assessment for a range of different species, the complexity of the exposure environment, the lack of suitable toxicological data. The poster will outline the main issues identified in the project and discuss the practicalities and possibilities of the GD framework.
and limitations were discussed and adequately addressed by scientific communities, applicants and authorities. As a result, a variety of accepted tools are now available for exposure assessment. In contrast, population modelling approaches used in ERA for effect assessment in ecotoxicology are still at a relatively early establishment stage. In this respect, although effect modelling is recognised as a beneficial tool for adding ecological realism to ERAs, EFSA has so far not published any guidance document. Population modelling is at least mentioned in several EFSA (draft) guidance and opinions as a refinement option. However, so far, outcomes of submitted effect modelling approaches in ERAs are not often considered by authorities. Many of the available models deal with protection goals that address field populations. Therefore, effect models are often stochastic and spatially explicit. This however makes these models more complex in comparison to the established deterministic exposure models and therefore considerable effort is needed for their verification, validation and comprehensive communication. Since effect modelling for ERA aims to predict effects on populations of the model organisms which arise from environmental exposure, we find it meaningful to use, in ecological models, the relevant data from the established fate models. This can make the modelling approaches more harmonised and probably would enhance their acceptance. Also, it illustrated the usability of data on environmental conditions which agree with the established fate models and could as well demonstrate the implications of different environmental conditions on springtail populations. For this purpose, we used an individual based population model which represents the life-cycle of springtails in a temperature dependent framework. Specifically, we calculated soil temperature series with the groundwater model Pearl. Further, we used climate variable series from the climate model of IPCC and selected variable pre-conditioned time series from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

**M0223 Dynamic modelling of fluxes of weathered polychlorinated biphenyls (PCBs) in soil: column experiments vs. modelling approaches in realistic environmental conditions**
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A column leaching experiment was performed to simulate realistic conditions that may be representative of different environmental scenarios and evaluate their influence on mobility and transport associated to dissolved organic carbon (DOC) and fine particles of aged polychlorinated biphenyls (PCBs) (PCB 28, 52, 101, 153, 138, 180, 209) in soil obtained from the Brescia-Caffaro contaminated site. The concentrations measured in leachates were compared to the results of simulations performed with an advanced dynamic air-litter-soil model (SoilPlus model) to investigate the predictive ability and the improvements needed to obtain better predictions. The variables taken into account were: 1) contact time between soil and water, 2) DOC content and quality in leaching solutions and in soil pore water, 3) fine particle-mediated transport, 4) temperature (and its influence on endogenous DOC production), 5) soil saturation conditions. These conditions were evaluated by scaling up from the leaching experiments to other variable pre-conditioned time series (2, 5, 7, 48 days), using leaching solution with different DOC content (tap water vs. a solution prepared with commercial humic acid), at different temperature (25 ° C vs. 15 ° C) and in saturated vs. pseudo field capacity conditions. Results indicated that equilibration time determined differences in measured PCB concentrations up to a factor of 8, probably due to the lack of equilibration with the endogenous DOC components in DOC measuring functions. The addition of endogenous DOC increased mobility (up to a factor of 4) especially for brief contact time (non-equilibrium conditions) and within the Log Kow range 6-7.5. Samples leached at room temperature showed concentrations up to a factor of 9 higher in comparison to samples collected at lower temperature probably because of the different amount of endogenous DOC produced. Samples kept in pseudo field capacity conditions for seven days and then flushed resulted in about double the concentrations of the samples flushed in saturated conditions with a brief contact time, showing that drying-wetting cycles may determine concentration peaks. These trends were not caught by the model predictions as well as the relevance of the transport associated to fine particles, pushing for incorporation of this dynamic in models.

**M0224 Assessing the trait-based ecological vulnerability of aquatic invertebrates for phenol**
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Recently, there has been considerable concern about the chemical accidents as usage and manufacture of phenol have increased. Phenol is harmful to living organisms and its exposure can cause ecological and economical damages. Therefore, it is necessary to prepare for possible chemical accident of phenol. The Korean government designated phenol as the accident preparedness substance and required to assess and manage the ecological risk of phenol. This study aimed to find the ecological risk at the scenario that phenol exposed to freshwater bodies in Korea. In particular, the vulnerability of aquatic invertebrates was explored to consider not only individual organisms also their populations. Vulnerability integrated the exposure, sensitivity, and recovery of the ecosystem by considering various traits (e.g., body length, food preference, toxicological sensitivity, recovery strategy, etc.). The traits were reviewed by published data or open sources, and respective scores were assigned by using multi-criteria analysis which transformed them to numerical values. The toxicological sensitivity was derived by indirect prediction based on traits because the available data was not possible. The results figured out the vulnerable invertebrates for phenol in Korean freshwater. In addition, the vulnerable species showed that the consideration of only sensitive species would not be great ecological risk assessment and management. This work was supported by Korea Environmental Industry & Technology Institute (KEITI) through "The Chemical Accident Prevention Technology Development Project", funded by Korea Ministry of Environment (MOE) (No. 2016001970001).

**M0225 Assessing and managing food-web effects of Plant Protection Products**
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Assessing impacts on biodiversity needs to integrate indirect effects ( trophic chain interactions, also referred to as food-web effects or effects on biodiversity. Plant protection law requires protecting biodiversity and data requirements for Plant Protection Product (PPP) active substances (Regulation EC 283/2013) also acknowledge this aspect by mentioning indirect effects to be considered in the assessment of the impact of PPPs on terrestrial ecosystems and water bodies. The report of the task force of PPPs has been well documented and recent scientific opinions of the European Food Safety Authority (EFSA) confirm the need for their inclusion in the environmental risk assessment of plant protection products. As a first step towards this direction, the currently renewed approval of glyphosate includes an obligation to the EU Member States to assess and manage the risk to diversity and abundance of non-target terrestrial arthropods and vertebrates via trophic interactions in the course of authorization procedures of glyphosate products. Therefore, we consider it necessary to develop an extension of the risk assessment to evaluate the indirect effects of specific PPPs in addition to the standard risk assessment and provide suggestions to risk managers on how to mitigate them. Due to the large variation in food web compositions and spatial and temporal implications, we do not consider it possible to achieve a representative and realistic estimate of indirect effects by means of mechanistic models. Instead, we suggest a simple empirical model to complement current risk assessment. However, implementing a risk assessment scheme for an additional subject of protection would not be feasible without offering solutions on how to manage the assessed risk. Otherwise, an adverse outcome of the assessment would inevitably lead to non-authorisations. To solve this conflict, we put forward an approach to manage risk by means of compensating food web effects. In practice, compensation is established by ecological compensation areas such as flowering margins, set-asides and beetle banks in field. To make most out of existing types of suitable measures and to enable a maximum of freedom of choice to farmers, we provide a points rationing scheme to categorise the individual measures with regard to their value for supporting in-field biodiversity (and thus to compensate for indirect effects of PPPs).

**M0226 Compensating for ecological risks of pesticides**
S. Matezki, K. Swarowski, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV plant protection products
Current environmental risk assessment (ERA) of pesticides overlooks a considerable part of existing risks and consequently fails to protect the environment from pesticide effects to retro. Examples of such blind spots are risks to field-dwelling species including wild pollinators, amphibians and farmland birds as well as risks for food web effects. Temporal and spatial implications are not sufficiently well described and highly relevant for the achievement of the legally defined environmental protection goals, eliminating these blind spots in the risk regulation has failed so far. The ‘indirect effect’-issue is an illustrative example for what we would actually regard as a crisis in environmental risks regulation of PPPs. What we recognize is that progress in ERA notably seems to be hampered for types of risk for which no effective risk assessment has been established, so that an assessment of such risks would inevitably lead to non-authorizations. To solve this conflict, we wish to put forward a radically new approach in risk management: Compensating adverse effects of pesticides where established methods of risk mitigation fail to prevent them. Once implemented into the iterative process of risk assessment, such new risk mitigation approaches would allow to manage actual risks more adequately than currently possible, thereby preventing an increase of non-authorizations. It has not escaped our notice that our proposal could also make excessive higher tier assessments dispensable, thereby helping to solve the problem of the increase of complexity in ERA.
Fish model species in human and environmental toxicology

**MO228**

**Historical control data of the optimized Zebrasfish Embryos Development Toxicity Assay (ZEDTA)**

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The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for this test. Therefore, a protocol based on the OECD guideline No. 236, has been developed and optimized by Charles River Laboratories Den Bosch, the Netherlands. Multiple studies were performed using the optimized protocol, which allowed for collection of historical control data on the frequency of malformations, mortality and development of the embryos/larvae exposed to the control treatment. In our protocol, embryos in the blastula phase (2-4 hours post fertilization (hpf)) were selected and exposed to adjusted ISO medium. Twenty four embryos (one embryo per well in a 24 wells plate), were exposed at a temperature of 26°C for a period of 96h. Exposure medium was renewed after 48 hours. Development was assessed daily using the Extended General Morphology Score (GMS). Teratogenic endpoints were scored as 'present' or 'absent' after 96 hours of exposure. The Extended GMS grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consisted of, but were not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf was 18. Teratogenic endpoints scored during the assessment comprise of malformations of sacculus/otoliths, head, heart, tail, yolk, pectoral fins and entire body. Data of twenty experiments were analysed. In total 400 embryos were exposed to control treatment (i.e. adjusted ISO medium).

The average mortality rate in the control treatment was 2.5% which was considered acceptable. In only three experiments a maximum mortality of 10% was reached, which was still considered acceptable. Sixty percent of surviving larvae scored the maximum of 18 points for development, whereas 32% scored 17 points at the end of exposure (100 hpf). The most frequently observed findings were malformations of yolk (3.3%) tail (3.1%), heart (2.3%) and head (1.3%). These findings were observed in 6.4% of surviving larvae only. Analysis of the historical control data shows that the used optimized protocol produces an optimal development rate of exposed embryos and larvae, with minimal mortality and a minimal background malformation rate. This indicates a low level of confounding factors and high reliability of results produced with our protocol.

**MO229**

**Optimization of the Zebrasfish Embryos Development Toxicity Assay (ZEDTA)**

D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuizen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for the ZEDTA. The aim of this research was to optimize the protocol, i.e. examine which combination of exposure parameters is optimal for embryonic and larval development and is at the same time most cost-effective. An optimal embryonic condition should yield normal growth and development with minimal mortality and/or malformations. The OECD guideline No. 236 was used as base. In our protocol embryos in the blastula phase (2-4 hours post fertilization (hpf)) are exposed to adjusted ISO medium. The following factors and their combinations were investigated: temperature (26 vs. 28°C), exposure vessels (24 vs. 96 well plates), renewal periods (static (no renewal) vs. semi-static (24 or 48 h renewal)), and use of solvent (0.05% v/v DMSO vs. adjusted ISO medium). Development was scored daily, using the Extended General Morphology Score (GMS). This system grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consist of, but are not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf is 18. Teratogenic endpoints such as malformations of sacculus/otoliths, head, heart, tail, yolk, pectoral fins and entire body were scored as 'present' or 'absent' after 96 hours of exposure. Mean developmental and teratogenic scores were calculated and used to select the most optimal condition for each factor. Our experiments showed that exposure in 24-well plates at a temperature of 26°C in combination with renewal of exposure medium after 48 hours of exposure produced the most optimal results with the lowest incidence of malformations. Daily renewal of medium provided similar results, but this was less cost-effective. Use of 0.5% v/v DMSO did not induce more malformations or mortality than exposure to adjusted ISO medium.

**MO230**

**Reliability of ecotoxicological studies in fish**

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The term evaluation in ecotoxicological valid bioassays are essential for deriving Environmental Quality Standard (EQS). The generally established biotests using the three toxic trophic levels - algae, invertebrate and fish - according to OECD Guidelines provide in particular the baseline data for the derivation of the EQS. To obtain the most accurate EQS by use of a low assessment factor of 10 data from all three trophic levels including long-term results are required. Depending on the test substance substance growth inhibition of algae, immobilization of daphnia as well as deformation and death of fish embryos are not necessarily the most sensitive organisms and endpoints. Fish are in many cases the most suitable test organisms to demonstrate effects of e.g. pharmaceuticals with a specific mode of action in vertebrates. Therefore, prolonged toxicity tests with fish are of great importance. However, the study design has to be adapted to specific endpoints according to the pharmacodynamics of the tested drugs. Thus, in planning and implementing this type of study special care must be taken to ensure that the generated data can be used for derivation of EQS. Even though several reporting and evaluation criteria for ecotoxicological studies have been published (e.g. Klimisch, Cred) up to date still numerous studies are available which do not fulfill these criteria and thus have to be excluded in the assessment process. Frequent failure sources include e.g. not statistically significant results, missing chemical analysis of test compound concentration in the test water, calculation of toxicological endpoints on the basis of nominal and not real concentrations, or insufficient quality of endpoints. The aim of the presentation is to outline, from our point of view, optimal experimental conditions of prolonged fish tests which can be adapted as a model for other scientific studies, through increasing the statistical results and considering so far neglected aspects such as possible background contamination of commercially available fish feed frequently used in fish studies.

**MO231**

**Assessment of the relationship between heavy metal bioaccumulation and biomarker responses in Japanese dace inhabit in heavy metal contaminated river**

H. Takeuchi, Toyo University / Research Center for Life and Environmental Sciences; Y. Iwasaki, National Institute of Advanced Industrial Science and Technology AIST Japan / Research Institute of Science for Safety and Sustainability; D. Kitamura, Toyo University / Graduate School of Life Sciences; Y. Kato, Toyo University / Faculty of Life Sciences; Y. Shimizu, Toyo University / Graduate School of Life Sciences; H. Tatsuta, University of the Ryukyus / Faculty of Agriculture; S. Kashiwada, Toyo University / Graduate School of Life Sciences

The Watarase River, running in the northern Kanto region of Japan, had been severely polluted by heavy metals due to Ashio mining activities from late 1800s to early 1900s (e.g. 20 mg Cu/L in river water in 1897). Although the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still higher than those in a unpolluted river, the Omoi River. In previous study, our group investigated the heavy metal accumulation status (Cu, Zn, As, Pb, Cd and Fe) in organs of Japanese dace Tribolodon hakonensis captured from mid reach sites in the Watarase and Omoi River, and also analyzed those river water and sediment concentrations. Water and sediment concentrations in the Watarase River were generally higher than those in the Omoi River, interestingly, whereas Zn, As, Pb and Cd concentration in liver of Japanese dace in the Watarase River were lower than those in the Omoi River. Additionally, although there were no significant genetic differences between both riverine dace in microsatellite analysis, bile metallothionein (cysteine-rich protein involved in metal detoxification) concentration of dace in the Watarase River was significantly higher than that in the Omoi River. It suggests that the dace inhabit in the Watarase River may have been adapted to metal contamination by biological responses not depending on genetic characteristics. In the present study, for understanding biological response mechanism of dace to the metal contamination, we analyzed multiple biomarkers (such as erythrocyte δ-aminolevulinic acid dehydratase activity, blood protoporphyrin and hemoglobin concentration, and bile metallothionein concentration) in dace captured in the Watarase and Omoi River, as well as metal accumulation status of those fish. In this presentation, we will show detailed results, and discuss about the relationship between heavy metal bioaccumulation and biomarker responses in riverine fish inhabit in metal contaminated river.

**MO232**

**Micronucleus test to evaluate effects of 4 metals on DNA damage of zebrafish**

A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiology; A. Perez-Rojas, Universidad Autonoma Metropolitana Iztapalapa / Lab. Limnology and geology; Department of Hydrobiology

Danio rerio is a species of importance since it is used as a test organism for ecotoxicological assessments at the International level. In our country the tests with this organism are only provided in medical research, for this reason
the objective of this study was to determine the toxic and genotoxic effect of the metals Cd, Cr, Cu and Pb which are present in the freshwater systems of the valley of Mexico, on juveniles of D. rerio, to evaluate the use of these fish as biosensors in environmental monitoring studies. Static bioassays were carried out with a duration of 48 hours, with each metal. Five toxic concentrations were used in duplicate, plus a non-toxic control. The LC50 was determined and with the surviving organisms the evolution of genetic damage was carried out, by means of the evaluation of frequency of micronuclei in blood cells (1000 cells). The results obtained showed that the toxicity of metals and their mixture, based on the LC50 calculated was: Cu > Pb > Mix > Cr > Cd. The Kruscal-Wallis test indicated that there are significant differences between the degree of genetic damage in exposed organisms to different metals and controls (0.05%). The metal with the highest genotoxic effect was lead (0.05%), followed by cadmium (0.05%). Copper showed the lowest genotoxicity (0.37%). The metal mixture had a micrornucleous frequency of 1.23 %. The juveniles of D. rerio had deleterious effects in concentrations of metals lower than the LMP (Maximum Permissible Limits) that marks the NOM 001 Semarnat for water discharges to natural systems, so it is possible that they can be used as biosensors in the studies of environmental monitoring.

MO233
Endocrine disruption effects of bisphenol S and bisphenol SIP in adult zebrafish (Danio rerio)
K. Ji, J. Lee, Yongin University
As alternative compounds of bisphenol A (BPA), bisphenol S (BPS) and 4-hydroxyphenyl 4-isopropylnaphthalene (BPSIP) are widely used in thermal paper products. These compounds have been detected in human urine samples; however limited information is available on their endocrine disrupting effects. Adult zebrafish pairs (Danio rerio) were exposed to environmentally relevant concentrations (0.0, 0.5, 5, and 50 μg/L) of BPS and BPSIP for 21 days, and the adverse effects on egg production, levels of sex steroid hormones, and transcription of genes related to hypothalamic-pituitary-gonadal (HPG) axis were investigated. The estrogenic (in 17β-estradiol/estosterone [E2/T] ratio) and anti-androgenic (decrease in T) effects were commonly observed in zebrafish exposed to BPS and BPSIP, and males were more sensitive to the adverse effects than females. Although the effective concentration for endocrine disruption was greater than that of BPS, the actions of BPSIP on the stereodigenic pathway were similar to the effects of BPS exposure. The commonalities and differences in the toxicity of BPS and BPSIP can be explained by their chemical structure: the phenolic hydroxyl group in the key structural component responsible for the estrogenic and anti-androgenic activities of bisphenol analogues. The results of the present study showed that exposure to low level BPS and BPSIP could affect regulatory systems of HPG axis in zebrafish at environmentally relevant concentrations.

MO234
Oxidative Stress Induced by PAH Metabolism: Comparing Three Exposure Routes in Red Drum, Florida Pompano, and Southern Flounder to DWB sugary mullet (1.5 g/kg), the concentration was 1000 μM of both BPS and BPSIP, and the endpoints were measured at 24 h post-exposure. The results showed that the PINP/BSAP ratio was significantly increased in the BPS and BPSIP-exposed groups compared to the control group. The antioxidant enzymes, including CAT, SOD, and GSH, were also increased in the BPS and BPSIP-exposed groups. The results of this study suggest that the exposure to BPS and BPSIP may cause oxidative stress in DWB sugary mullet. Additionally, the results of the current study provide new insights into the mechanisms underlying the effects of PAHs on oxidative stress in DWB sugary mullet. Further studies are needed to elucidate the specific pathways involved in the oxidative stress response induced by PAHs in DWB sugary mullet.

MO235
Impact of PAH/oxo-PAH mixtures on heart development in zebrafish
V. Cunha, K. Dreij, Karolinska Institutet
Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that have been widely studied. Oxygenated PAHs (oxy-PAHs) are also found in the environment and are emitted from the same primary sources as PAHs but also can be formed through secondary oxidation of PAHs. However, relatively little is known about their environmental fate and toxicity. The aim of this work was to determine the effects of binary PAH/oxo-PAH mixtures on cardiac development in zebrafish (Danio rerio) embryos (ZFes). ZFes (24 hpf) were exposed to a dose range of single PAH (benzo[a]pyrene, BP), oxo-PAH (the ketones 4H-cyclopenta[d]pyrene-4-one (4H-CP), benzo[a]fluorenone (BFO) and 6H-benzo[c]pyrene-6-one (6H-BPO)) or their binary mixture for 4 days. After exposure, ZFes were observed for effects on heart development, heart rate and blood flow. Samples were also collected for gene expression analysis. The results showed abnormal cardiac development, such as formation of string hearts where exposure to 6H-BPO and BFO in combination with BP was more potent than single exposures. The heart rate and blood flow was significantly decreased, in a dose-dependent manner, in ZFes exposed to 6H-BPO alone and in combination with BP. With the other oxo-PAHs, a decrease in the heart rate was observed, however in a non-monotonic response to the treatments. Blood flow was also decreased but only for BFO and 4H-CP in mixture with BP. Gene expression analysis showed significant up-regulation of genes involved in cardiac development and mortality in the zebrafish heart. The findings of this study suggest that oxidative stress may play a role in the adverse effects observed in zebrafish exposed to PAH/oxo-PAH mixtures.

MO236
Induction of developmental cardiotoxicity in rainbow trout (Oncorhynchus mykiss) following PAH mixture exposure - new insights using an integrated OMICS approach
A.N. Eriksson, C. Rigaud, University of Jyväskylä / Department of Biological and Environmental Science; A. Krasno, NOFIMA; J. LiHAVAINEN, University of Helsinki; A. Ronkka, S. Saraei, T. Suomi, A. Laiho, L. Elo, University of Turku and Åbo Akademi University; E. Vehmänen, University of Jyväskylä / Department of Biological and Environmental Science. Worldwide, environmental levels of polycyclic aromatic hydrocarbons (PAHs) have increased over the last century, mainly due to anthropogenic release from incomplete combustion of organic material and oil spills. These compounds are present as a complex mixture in the environment and are known to cause developmental abnormalities, cardiototoxicity, immunosuppression, tumors and alterations in the expression of genes involved in cardiac function. The aim of this work was to investigate the cardiotoxic effects of two binary PAH mixtures (M025 and M026) in zebrafish (Danio rerio), and to evaluate the effects using an integrated OMICS approach. The first mixture (M025) contained 6H-benzo[c]pyrene (6H-BP), and the second mixture (M026) contained 4H-cyclopenta[d]pyrene-4-one (4H-CP). The results showed that exposure to M025 caused significant increases in the frequency of abnormal heart development (benzo[a]pyrene-4-one (4H-CP), benzo[a]fluorenne (BFO) and 6H-benzo[c]pyrene-6-one (6H-BPO)) or their binary mixture for 4 days. After exposure, ZFes were observed for effects on heart development, heart rate and blood flow. Samples were also collected for gene expression analysis. The results showed abnormal cardiac development, such as formation of string hearts where exposure to 6H-BPO and BFO in combination with BP was more potent than single exposures. The heart rate and blood flow was significantly decreased, in a dose-dependent manner, in ZFes exposed to 6H-BPO alone and in combination with BP. With the other oxo-PAHs, a decrease in the heart rate was observed, however in a non-monotonic response to the treatments. Blood flow was also decreased but only for BFO and 4H-CP in mixture with BP. Gene expression analysis showed significant up-regulation of genes involved in cardiac development and mortality in the zebrafish heart. The findings of this study suggest that oxidative stress may play a role in the adverse effects observed in zebrafish exposed to PAH/oxo-PAH mixtures.

MO237
Assessment of the developmental cardiotoxicity of individual PAHs using integrated OMICS approaches
C. Rigaud, A.N. Eriksson, University of Jyväskylä / Department of Biological and Environmental Science; A. Krasno, NOFIMA; M. KEINÄNEN, University of Eastern Finland; A. Rokka, University of Turku; S. Saraei, T. Suomi, A. Laiho, University of Turku and Åbo Akademi University; L. Elo, University of Turku; J. LIHAVAINEN, University of Helsinki; E. Vehmänen, University of Jyväskylä / Department of Biological and Environmental Science. Fish early life stages (ELS) are among the most sensitive organisms to developmental toxicity caused by polycyclic aromatic hydrocarbons (PAHs), which
includes detoxification enzymes induction (CYP1A), hemmorhaging, cardiovascular defects, pericardial and yolk sac edemas, craniofacial deformities or growth attenuation. The cardiovascular tissue is one of the most sensitive to PAHs, and all the aforementioned symptoms are caused by the activation of the aryl hydrocarbon receptor (AhR). However, the mechanisms involved downstream of the AhR activation by PAHs are still unclear. Some weak AhR agonists such as phenols can also activate the AhR via direct effects (e.g. arborinum) via unknown AhR-independent mechanisms. In this study, we are trying to explore the mechanisms of toxicity of individual PAHs in the rainbow trout (Oncorhynchus mykiss) ELS by the use of an integrated OMICS approach, i.e. the combined use of transcriptomics, proteomics and metabolomics. The use of OMICS can lead to evidence of which pathways are altered by PAHs, and thus help choosing candidate genes to be used as biomarkers of their mechanism of toxicity. Newly hatched rainbow trout larvae were exposed to three different PAHs (retene, pyrene or phenanthrene) at sublethal doses. The heart of each larva was sampled after 1, 3, 7 or 14 days of semi-static exposure, and RNA, proteins and metabolites were extracted. Morphometric parameters such as larval length and yolk sac area were also monitored, but were barely affected by PAHs. Preliminary data from transcriptomics and metabolomics showed different signatures of gene expression alteration as well as different metabolite profiles between treatments, suggesting specific mechanisms of toxicity. Overall, all compounds induced more changes in cardiac gene expression during the very first days of development, with the exception of pyrene which was also very potent after 7 days. Preliminary enrichment analysis (over-representation analysis) revealed that differentially expressed genes were mainly involved in immunity, oxidative stress, cardiac development and pyrenergene. P540, cation transport, muscular contraction or steroid hormone biosynthesis in the case of retene. Some of those processes were shared by pyrene. Phenanthrene appeared to alter collagen biosynthesis, as well as the glutamate release cycle, but only at one sampling point and with very few genes involved. Proteomic analyses are underway to further highlight the mechanisms of toxicity.

MO238 Developmental Toxicity of a Non-steroidal Anti-inflammatory Drug (Acetaminophen), in African Catfish (Clarias gariepinus) embryos. L.1 Ezemanye, University Benin / Animal and Environmental Biology; N.O. Ezemanye, University of Benin, Benin City, Nigeria / Animal and Environmental Biology; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology.University of Benin, Nigeria; P. Adebayo, University of Benin / Animal and Environmental Biology.

The study investigated the developmental toxicity of Acetaminophen, a non-steroidal Anti-inflammatory Drug on the early life stage (0 to 96 hpf) of African Catfish (Clarias gariepinus). The 96 hrs fish embryo acute toxicity (FET) test was carried out according to the modified OECD 236 guidelines. Newly fertilized embryos were exposed to different concentrations (0, 0.5, 1, 5 and 10 μg.L⁻¹) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural effects were observable within 96 hpf. Exposure of the embryos by acetaminophen significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisonous symptoms were recorded at higher dose. Exposed embryos were observed to have poorly formed somite’s, coagulated embryos, non-detached tail, altered spontaneous movement and inhibited swimming performance. Observed physiological alterations include cardiac edema, sac yolk edema, pericardial edema, tail malformation and lordosis. The result demonstrated that acetaminophen has the potential to alter the development of the early life stage of the African catfish.

MO239 In vitro approach for the identification of early warming biomarkers, related to exposure to PBDEs, in human and marine systems: oxidative stress, toxicity and cell cycle modulation. C. Espinosa, S. Manuguerra, M. Morghese, UniPa / DiSTeM; A. Cuesta, M. Esteban, University of Murcia / Fish Inname Immune System Group, Department of Cell Biology and Histology.; A. Santulli, Consorzio Universitario della Provincia di Trieste / Department of Veterinary Science; F. Demarin, University of Padua / Immunologia Molecolare (IBIM); A. Cuttitta, M. Sprovieri, CNR / IAMC Trapani, / Istituto di Biologia marina; F. Cibella, CNR / Istituto di Biomedicina e Esteban, University of Murcia / Fish Innate Immune System Group, Department of C. Espinosa, S. Manuguerra, M. Morghese, UniPa / DiSTeM; A. Cuesta, M. Cuesta, M. Cuesta.

In an effort to develop an in vitro method based on protein modeling followed by molecular docking using free online tools. We inferred dissociation constants for 3 different PAHs to these specific proteins, in particular the L-FABP (Liver-Fatty Acid Binding Protein) and the serum albumin. However, the data concerning the binding affinities of PAHs to these specific proteins are rare, refer mainly to mammalian proteins and to abundant one of the mentioned model the interactions between the fish. Moreover, biochemical in vitro approaches are often not possible due to the lack of purified proteins for most common fish species. The use of in silico approaches such as protein structure modeling and molecular docking between the chemical and the proteins of interest, may improve our ability to evaluate chemically protein interaction and allow the extrapolation of biochemical parameters, such as binding constants. This kind of data would be helpful in building more refined toxicokinetics model in aquatic organisms. Here we present a simple two-step method based on protein modeling followed by molecular docking using free online tools. We inferred dissociation constants for 3 different perfluoroalkyl acids (Perfluorooctane Sulfonate, PFOS, perfluorohexane sulfonate, PFHxS) and multi-levels polyfluoroalkylene ethers (PFOS, PFHxS) and the serum albumin. Comparison with experimental data on the human protein showed that this approach provides estimates that range in the same magnitude as those obtained by experimental approaches, such as ligand displacement assays.

MO240 In silico estimate of affinity constants for perfluorinated compounds in rainbow trout (Oncorhynchus mykiss) proteins. D. Dejoli Esposti, Iristea / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Iristea / Université Rennes 1; R. Casadio, University of Bologna / Department FaBiT; M. P. Babut, Iristea / Water Perfluoroalkyl substances (PFAs) represent an important class of environmental contaminants which have been widely detected in humans and wildlife as well as in surface waters and aquatic sediments. PFAs have been shown to accumulate in aquatic species and some of them have displayed reproductive and development toxicity, hepatotoxicity and behavioral effects. Numerous studies in fish and mammals have demonstrated higher PFC concentrations in liver and blood compared to other organs. Such a distribution could be explained by PFAS binding to specific proteins, in particular the L-FABP (Liver-Fatty Acid Binding Protein) and the serum albumin. However, the data concerning the binding affinities of PFAS to these specific proteins are rare, refer mainly to mammalian proteins and to abundant one of the mentioned model the interactions between the diabetes mellitus type II. At the same time, metformin is also used as therapy agent for women with polycystic ovary syndrome (PCOS), a reproductive abnormality disease, and is being screened as a potential anti-cancer drug. Therefore, just in Germany metformin usage has almost tripled in the last 10 years to 1,100 tons (2010) and it is still increasing. As a consequence of the high consumption, the pharmaceutical is detectable at relatively high concentrations in both waste water treatment plant effluents and surface waters around the world, even though most of the substance gets removed during conventional active sludge treatment. Since most of its active form (up to 100%) get excerted through urine and faeces, the poor metabolisation rates of metformin in humans add to this outcome. As a consequence, metformin poses a potential risk for aquatic organisms and ecosystem within the water cycle. In order to determine potential adverse effects on aquatic organisms, zebrafish (Danio rerio) embryos were exposed to metformin hydrochloride (C₇H₁₄N₂·HCl) according to OECD test guideline 216 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. 'n

MO241 Impact of metformin on zebrafish (Danio rerio) embryos. S. Mizek, University of Heidelberg / Aquatic Ecology and Toxicology; T. Braunbeck, University of Heidelberg / Centre for Organisal Studies

The biguanide metformin is an insulin-sensitising agent through its characteristics to increase peripheral glucose uptake and to decrease hepatic gluconeogenesis and insulin secretion. Through its anti hypertensive effect, metformin is one of the most commonly prescribed anti-diabetic medical treatments during the diabetes mellitus type II. The effect of metformin on zebrafish (Danio rerio) embryos was exposed to metformin hydrochloride (C₇H₁₄N₂·HCl) according to OECD test guideline 216 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. 'n

MO242 Pyrogallo and its structurally related compounds on animal cytochrome c oxidase activity. Y. Kim, K. Kim, H. Jeon, H. Kim, Y. Choi, S. Lee, Kyungpook National University.

Pyrogallol is a benzenetriol being a brownish solid, and is used for hair dyes after mixing with copper sulphate. A recent report on mutagenicity of acid pyrogallol (Acetaminophen) in African Catfish (Clarias gariepinus) embryos. (Acetaminophen) has the potential to alter the development of the early life stage of the African catfish. Pyrogallo and its structurally related compounds are rare, refer mainly to mammalian proteins and to abundant one of the mentioned model the interactions between the diabetes mellitus type II. At the same time, metformin is also used as therapy agent for women with polycystic ovary syndrome (PCOS), a reproductive abnormality disease, and is being screened as a potential anti-cancer drug. Therefore, just in Germany metformin usage has almost tripled in the last 10 years to 1,100 tons (2010) and it is still increasing. As a consequence of the high consumption, the pharmaceutical is detectable at relatively high concentrations in both waste water treatment plant effluents and surface waters around the world, even though most of the substance gets removed during conventional active sludge treatment. Since most of its active form (up to 100%) get excerted through urine and faeces, the poor metabolisation rates of metformin in humans add to this outcome. As a consequence, metformin poses a potential risk for aquatic organisms and ecosystem within the water cycle. In order to determine potential adverse effects on aquatic organisms, zebrafish (Danio rerio) embryos were exposed to metformin hydrochloride (C₇H₁₄N₂·HCl) according to OECD test guideline 216 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. 'n

MO243 Pyrogallic acid and related compounds inhibit cytochrome c oxidase. Y. Kim, K. Kim, H. Jeon, H. Kim, Y. Choi, S. Lee, Kyungpook National University.
which is vital for energy production and is located in mitochondrial membranes. COX activities from zebrafish (Danio rerio), Doryxodon (Doryxodon aeneus), earthworms (Eisenia fetida), and the lesser rice weevil (Sitophilus oryzae) were placed to be inhibited by pyrogallol and its related chemicals such as gallic acid, 1,2,4-benzenetriol, pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid. For the inhibition of zebrafish COX, pyrogallol was the strongest chemical among the tested ones, with an IC50 of 0.09 ± 0.02 µM, inhibiting COX activity by 31.4% at 10 ppm. Gallic acid and 1,2,4-benzenetriol showed potent inhibition on the COX activity with the concentration of 100 ppm. At a 10-times diluted concentration, these three compounds showed moderate inhibition on the enzyme activities. These phenomenon were applied all of the tested animals. Pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid did not show any inhibitory effect on the COX activity. Taken together, benzenetriols including pyrogallol may be caused by unexpected inhibitory effects on the animal COX activity, referring fluctuation of the energy production, and the benzenetriol moiety is essential for the inhibition on the COX activity.

MO243 Exposure to environmental concentrations of Triclosan induces oxidative stress and genotoxicity on zebrafish (Danio rerio) embryos C. Parenti, A. Ghilardi, M. Mandelli, University of Milan; C. Della Torre, State University of Milan / Biosciences; S. Magni, University of Milan / Department of Biosciences; L. Del Giacco, University of Milan; A. Binelli, University of Milan / Department of Biosciences; T. Takahashi (TCS, 5-chloro-2-(2,4-dichlorophenox) phenol) is the most common antibacterial agent used in personal care products, including soaps, body lotions, laundry detergents, toothpastes and deodorants. For its properties it is also added to several household items such as food packaging materials, toys and textiles. Since TCS is not completely removed by Waste-Water Treatment Plants (WWTPs), it is becoming a potential worldwide pollutant and it is frequently detected in surface waters, with concentrations ranging from ng/L to µg/L. These evidences indicate that TCS is acutely and chronically toxic to aquatic organisms and it was already demonstrated that this chemical severely affects both zebrafish adult and embryos, causing embryotoxicity, hatching delay and biomarker alterations. Thus, the European Union (EU) has disapproved in 2016 the use of TCS in biocidal products, due to its unacceptable environmental risk. Meanwhile, consumer antiseptic wash products containing TCS can no longer be marketed in US. The aim of this study was to investigate the adverse effects of TCS at environmental concentrations on zebrafish embryos up to 120 hours post-fertilization (hpf). It is the first time that environmental levels of this contaminant were taken into account, instead of evaluating the effects of sub-lethal or lethal concentrations. The experimental plan consisted in the exposure to different environmental concentrations of TCS (0.1 and 1 µg/L) for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of TCS such as the generation of oxidative stress and DNA damage. The activity of antioxidant and detoxifying enzymes, namely catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPx) and glutathione-S-transferase (GST), were measured, while the genetic damage was evaluated as the occurrence of the micronucleated cells (MN test). Results show a significant increase in all biomarkers measured, indicating that this chemical is dangerous for aquatic species also at environmental concentrations.

MO244 Comparative study of acute toxicity of a Microcystis aeruginosa bloom containing microcystin-LR on common carp Cyprinus carpio and Wistar rat Z. Hadjer, R. Bordj, H. Nasri, Laboratory of Biodiversity and Ecosystem Pollution, University of El Tarf, Algeria.; N. Bouaicha, UNIVERSITE PARIS MO244 The occurrence of harmful cyanobacterial blooms in surface waters is often associated by a production of variety of cyanotoxins that represent a hazard for human and animal health. Microcystins (MCs) are the most common cyanotoxins and may be expected wherever blooms of cyanobacteria occur in surface waters with more than 100 variants have been characterized. Among these cyanotoxins, microcystin-LR (MC-LR) is the most studied congener due to its high toxicity and frequent occurrence in surface waters. The purpose of the present study was to investigate the effects of 12-week gavage of a Microcystis aeruginosa bloom containing mainly the congener MC-LR (>95%), in male and female of juveniles (200 g weight) common carp (Cyprinus carpio). The fishes were been randomly assigned to three groups. Group I is the control group, received daily physiological serum (500 µL) containing main the 2 and 10 µg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated. In addition, the results of the histological study and biomarkers of oxidative stress have shown that male fish are much more sensitive to the bloom of cyanobacteria containing microcystins than females. Key words: MC-LR, Cyprinus carpio, oxidative stress, histological study.

MO245 Subchronic toxicity of a Microcystis aeruginosa bloom extract containing mainly the microcystin-LR congener on the common carp Cyprinus carpio R. Bordj, Z. Hadjer, H. Nasri, Laboratory of Biodiversity and Ecosystem Pollution, University of El Tarf, Algeria.; N. Bouaicha, UNIVERSITE PARIS MO245 The occurrence of harmful cyanobacterial blooms in surface waters is often associated by a production of variety of cyanotoxins that represent a hazard for human and animal health. Microcystins (MCs) are the most common cyanotoxins and may be expected wherever blooms of cyanobacteria occur in surface waters with more than 100 variants have been characterized. Among these cyanotoxins, microcystin-LR (MC-LR) is the most studied congener due to its high toxicity and frequent occurrence in surface waters. The purpose of the present study was to investigate the effects of 12-week gavage of a Microcystis aeruginosa bloom containing mainly the congener MC-LR (>95%), in male and female of juveniles (200 g weight) common carp (Cyprinus carpio). The fishes were been randomly assigned to three groups. Group I is the control group, received daily physiological serum (500 µL) containing 2 and 10 µg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated. In addition, the results of the histological study and biomarkers of oxidative stress have shown that male fish are much more sensitive to the bloom of cyanobacteria containing microcystins than females. Key words: MC-LR, Cyprinus carpio, oxidative stress, histological study.

MO246 Diluted bitumen vs. conventional crude oil: effects of developmental exposure on first- and second-generation zebrafish D. Lyons, University of Alberta; D. Philibert, K.B. Tierney, University of Alberta / Biological Sciences MO246 The Canadian oil sands industry produces a heavy, viscous crude oil called bitumen. Due to its viscosity, bitumen must be diluted with natural gas condensates to create a dilbit or “diluted bitumen” product that can be transported by pipeline or tankers. The composition of dilbit differs greatly in chemical composition compared to conventional crude oils and the impact of dilbit exposure on aquatic organisms has not been well characterized, despite its widespread transport across North America. In this study, the effects of developmental exposures on breeding success and next generation embryos were compared between dilbit and two conventional crude oils (mixed sweet and medium sour). Zebrafish embryos were exposed to water accommodated fractions of these oils from 0-7 days post fertilization (dpf) and gene expression and DNA methylation were measured at 7 dpf. Exposed embryos were then grown to adulthood in clean water. These fish were bred and their embryos were collected and reared in clean water (unexposed second-generation embryos). Breeding success of the first-generation developmentally exposed fish was determined by measuring the number of pairs that spawned, number of eggs spawned, fertilization rate, and survival of unexposed offspring. Gene expression and DNA methylation were also measured in 7dpf offspring. Developmental exposure in the first generation did not affect the survival of embryos and also did not affect breeding success when compared to control, but differed among exposure groups. Some target genes were differentially expressed in the exposed second-generation embryos when compared to control, indicating a potential change in the expression profile. This change in gene expression could potentially be due to changes in DNA methylation caused by the developmental exposure in the first-generation. Understanding what changes in DNA methylation mean for fish survival will require further study. Overall, it appears that developmental exposures to bitumen or “dilbit” do not have any clear toxic effects on first- and second-generation zebrafish embryos. Though second-generation endpoints are often overlooked, they are important to consider when evaluating the overall risk of oil exposure.

MO247 Effect of skate and its metabolites on phase I metabolism V. Zlabek, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters, LECHB; V. Burkina, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters South Bohemian
Cytochrome P450 (CYP) enzymes are dominant players in metabolism of xenobiotics and a wide range of endogenous compounds. Skatole is well known mammalian metabolite, however rarely considered as environmental relevant pollutant. In fact, presence of skatole in air,的发生 and receptor is to some organism due to its biological effects. To the best of our knowledge, no studies attempted to investigate the effect of skatole and its major metabolites on piscine CYPs. The aim of this study was to identify weather skatole and its metabolites, 2-aminoacetophenone, indole-3-carbinol, 3-methylindole, and 3-hydroxy-3-methylindole, can interact with fish CYP isoforms. Enzyme activity tests for CYP1A2 in rainbow trout hepatic microsomes were measured in the presence or absence of skatole and its metabolites. Following concentrations of tested inhibitors were used: 0.5; 5 and 50 μM. Skatole and indole-3-carbinol showed no inhibition potency on either CYP1A2 or CYP2A2. 2-Aminoacetophenone, 3-methylindole and 3-hydroxy-3-methylindole reduced CYP1A2 enzyme activity by approximately 25-35%, whereas CYP2A2 activity remained unaltered. Physiological consequences of such inhibition for fish ability to detoxify xenobiotics remain to be elucidated. Keywords: rainbow trout, cytochromes, EROD, COH Acknowledgement - The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic, projects CENAKVA (No. C2.1.05/2.1.0001.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15082S) and Swedish University of Agricultural Sciences.

MO248 Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights A. Zenker, University of Appl. Sc. Northwestern Switzerland / Institute of Environmental Toxicology; N. Munz, University of Applied Sciences and Arts Northwestern Switzerland

The herbicide glyphosate and the pharmaceutical lisinopril are among the most popular chemicals that have been detected in many streams at low concentrations. Nevertheless, the ecotoxicological properties, especially of lisinopril, are largely unknown. The objective of the study was to find early detection markers by comparing in vivo effects and geneexpression patterns in the fish embryo acute toxicity (FET) test and early-life stage toxicity test (ELS). Per substance 480 individuals of zebrafish were exposed to five different concentrations (lisinopril: 0.03 – 0.5 mg/L; glyphosate: 0.006 – 0.1 mg/L) and analysed for different morphological endpoints such as spontaneous movements, heart rate, hatching success and melanophore development. The expression patterns of the hPR (hormone responsive receptor) are influenced. The SOD1 gene expression was significantly increased because of glyphosate exposure whereas SOD2 and NPPB gene expression were not affected. The herbicide glyphosate and the pharmaceutical lisinopril are among the most popular chemicals that have been detected in many streams at low concentrations. Nevertheless, the ecotoxicological properties, especially of lisinopril, are largely unknown. The objective of the study was to find early detection markers by comparing in vivo effects and geneexpression patterns in the fish embryo acute toxicity (FET) test and early-life stage toxicity test (ELS). Per substance 480 individuals of zebrafish were exposed to five different concentrations (lisinopril: 0.03 – 0.5 mg/L; glyphosate: 0.006 – 0.1 mg/L) and analysed for different morphological endpoints such as spontaneous movements, heart rate, hatching success and melanophore development. The expression patterns of the hPR (hormone responsive receptor) are influenced. The SOD1 gene expression was significantly increased because of glyphosate exposure whereas SOD2 and NPPB gene expression were not affected.

MO249 New insights on cross-species differences in the modulation of human and zebrafish nuclear receptors by single chemicals and environmental mixtures N. Creusot, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; C. Garoce, INERIS; A. Bouhalouf, INSEERM / IRCM - U1194; F. Brion, INERIS / Ecotoxicology Unit; W. Bourguet, CBS CNRS UMB5308 - INSERM U1054; A. Escande, Universite de Montpellier; M. Grimaldi, INSEERM / IRCM - U1194; S. Ait-Aissa, INERIS / UMR SEBIO ECOT; P. Balaguer, INSEERM / IRCM - U1194

In the context of contamination of aquatic ecosystems by endocrine disrupting chemicals (EDCs), this work aims to provide new insights on cross-species differences in the modulation of nuclear receptors (NRs) by dietary hydrogen cyanide receptor (AhR) by individual chemicals and environmental mixtures, in order to help further cross-species extrapolation in the frame of the environmental risks of EDCs. To this end, a panel of individual ligands and environmental mixtures from seawaters and rivers, resulting in the contamination of the aquatic ecosystem. Consequently, it is urgently needed to evaluate the potential toxicity to aquatic organisms. The zebrafish has emerged as a powerful model organism to study various aspects of developmental and cell biology, while it provides an alternative model for toxicological studies. The objectives of this study were to assess to what extent EDCs induce toxicity in zebrafish embryos. In addition, we evaluated the uptake and biotransformation of TCS by zebrafish and examined whether biotransformation data could be used complementary to the concentration of the parent TCS to interpret the induced toxicity. The final goal was to establish a wide-scope targeted metabolomics screening workflow to investigate the induced toxicity in a biochemical perspective and associate the observed toxicity/phenotype with changes in molecular level. Overall, the aim was to highlight a high throughput testing approach. The incorporation of different determination approaches, for a comprehensive toxicity assessment of environmental stressors in aquatic organisms. The zebrafish embryo toxicity assay was used to calculate the LC50 value of TCS as well as to perform the morphological phenotyping. In addition, a liver specific fluorescent transgenic line (Tg:LFABP:GFP) was used, to evaluate TCS liver toxicity potential. Concerning the toxicokinetics and the metabolomics experiment, 96 hpf zebrafish embryos were used. Samples were collected at 5 different time intervals, from 30 s up to 24 hours post exposure (hpe). Detection and identification of tentative TCS-bio-TPs was performed through in-house developed suspect and non-target screening workflows. Bio-TPs arising from both oxidative and conjugative metabolic reactions were identified. Regarding the metabolomics part of the study, a database of over 600 endogenous metabolites (carboxylic acids, amines, nucleotides etc.) was established creating a broad overview of all known bio-TCs. Prostaglandin F2-like derivatives have emerged as a reliable biomarker for oxidative stress in mammals and fish namely the F2-isoPs (F2-IsoPs). F2-IsoPs are the free-radical catalyzed products of non-enzymatic lipid-peroxidation of arachidonic fatty acid, a fatty acid found in brain tissue and cell membranes. Fish mucus has been investigated in several studies as a potential biomarker matrix for the detection of oxidative stress. It is composed mainly of glycoproteins, but notably contains immunoglobulins, pheromones, lysozyme and proteolytic enzymes. Mucus is known to have important biological functions for fish, ranging from communication and reproduction to osmotic regulation. To date, no method for the isolation and quantification of F2-IsoPs in fish mucus has been reported. The aims of this study was to develop an efficient method for the extraction of F2-IsoPs from fishes and to optimize the resolution and quantification of F2-IsoPs by high performance liquid chromatography tandem mass spectrometry. The method was based on acidification of mucus with HCl and extracting with ethyl acetate. The
extract was then centrifuged, filtered and reconstituted in methanol. Separations were performed on C18 (2 mm x 50 mm, 3.5 mm particle size) using methanol (0.1% formic acid) and water as the mobile phase. Negative ion electrospay ionization and specific multiple reaction monitoring ion transitions were used to detect F2-isops in mucus. Mass labelled internal standards were used to monitor recovery of native compounds during sample work-up and also to quantitate native F2-isops. Naturally occurring F2- and VI-Fs isops were measurable in Crapppie (Pomoxis). This work demonstrates that mucus has the potential to be used as a non-invasive, non-lethal matrix for F2-Isops analysis in fish.

MO252 Validation of in ovo embryo microinjection to simulate maternal transfer of selenomethionine in the fathead minnow (Pimephales promelas)  T. Lane, University of Saskatchewan; D. Green, K. Raes, University of Saskatchewan - Toxicology Centre / Toxicology; K. Bhum, University of Saskatchewan / School of Environment and Sustainability; D.M. Janz, K. Liber, L.E. Dong, University of Saskatchewan / Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre.

Selenium (Se) is a naturally occurring trace element that is recognized as a contaminant of concern in Canadian aquatic ecosystems because of its high potential to bioaccumulate and persist even after its source has been removed. All animal classes are susceptible to the effects of Se due to the narrow range between dietary essentiality and toxicity; however, oviparous vertebrates, especially fish, are at an even greater risk for the maternal transfer of Se. The objective of this study was to develop and validate an embryo injection approach to model maternal transfer of selenomethionine (SmE), the primary form of Se in the diet. This model could then be applied to any egg-laying species of interest and could provide insight regarding differences in species sensitivity to Se toxicity during early life stage development. Initially, the maternal transfer of dietary SeM and its effect on the F1 generation was characterized in a short-term fish species (ninespine stickleback) and freshwater systems, the fathead minnow (Pimephales promelas). 20 breeding groups (3 females:2 males) were fed a SeM-spiked diet of either 0, 3, 9, or 27 µg/kg bw of SeM and bled for 28 days. Embryo Se concentrations increased immediately upon onset of exposure and Se concentrations reached approximately a 1:1 ratio in food:embryo after 28-29 days on the diet. There was a significant difference in mean embryo Se concentrations from the control (1.18 mg/kg embryo dw) in the medium (8.75 µg/kg embryo dw) and high (29.58 µg/kg embryo dw) treatment groups. Embryos collected on days 26, 27, and 28 were reared to swim-up and assessed for morphological abnormalities. Preliminary assessment revealed an increasing, although not significant, trend in the frequency of deformities between the control and high treatment groups (p=0.057); however, a more robust analysis is ongoing. Average Se embryo concentrations from this study will serve as the basis for subsequent embryo injection studies in fathead minnow. Developmental endpoints from both studies (e.g. mortality, frequency of deformities, types of deformities, severity of deformities) will be compared to determine if the embryo injection model is an appropriate risk for studying the maternal transfer of Se. The embryo injection model could also support mechanic and omic-based research in long-lived species of concern, such as white sturgeon, or in recreationally fished species such as walleye, brook trout and northern pike.

MO253 Preliminary characterization of the rainbow trout intestine using omics based approaches.  L.M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences.

Intestinal function is central to the physiology, health and disease of numerous organisms. However, little is known about its gene or protein profile in trout, a widely studied and environmentally relevant model laboratory organism (Oncorhynchus mykiss). In this study, two omics based tools focused on characterizing RNA and protein expression were used to establish the ontology of each intestinal region viz. the pyloric, anterior, mid and posterior region. RNA was sequenced and mapped to the rainbow trout genome (84%). Following filtering for transcript abundance using TPM and a p-value cut off, 23,635 – 25,435 contigs were identified over the 4 regions and included enzymes involved in metabolism of chemicals such as the cytochrome P450 family (CYPs). Differential expression of genes between regions did not vary significantly between the pyloric, anterior or mid intestine (~6 genes), however this changed markedly between the pyloric and posterior region (~29) highlighting their differences. Proteomic characterization established over 3,899 proteins present in the intestine with annotated proteins varying from 3,100 to 3,899 dependent on intestinal region. Significant differences in proteins were observed between intestinal regions further confirming trends observed in the parallel transcriptomic study. These data represent the first thorough characterization of the rainbow trout intestine, and will allow the identification of enzymes present in this organ which may be responsible for xenobiotic metabolism.

MO254 Persistent organic pollutants alter the expression patterns of epigenetic factors in the Zebrafish Liver (ZF-L) Cell line.  M. Blanc, Ocrebo University / MTM Research centre; N. Scherbak, Ocrebo University / School of Science and Technology, Life Science Centre; S. Keiter, Ocrebo University / MTM Research centre.

Several studies demonstrated that exposure to persistent organic pollutants can induce epigenetic modifications in human and other vertebrates. In zebrafish, it is of particular interest since epigenetic changes were reported in ontologies with increasing incidence such as cancer. Besides, epigenetic disruption was suggested to be one mechanism responsible for multigenerational effects of chemical exposure. Epigenetic pathways in zebrafish are similar to mammalians; therefore, it was proposed as an alternative model for epigenetic research. The focus of the present study was set on the investigation of epigenetic effects in the Zebrafish Liver (ZF-L) cell line after 48 h of exposure to 8 selected compounds. The cells were exposed to the LC10 values of pesticides (methoxychlor (MIX), permethrin (PER)), plastic additives (bisphenol A (BPA) and S (BPS)), perfluorinated compounds (perfluorooctane sulfonic acid (PFOS), perfluorobutane sulfonic acid (PFBS)), a whitening agent, 7-dihydrouracil-4-methyl coumarin (DEM), and to the water solubility value of the pesticide vinclozolin (VCZ). The DNA methyltransferases were selected to target DNA methylation and histone modifications were monitored using RT-qPCR. The DNA methyltransferases were selected to target DNA methylation and histone modification sites were selected using MT-PCR. The DNA methyltransferases were selected to target DNA methylation and histone modification sites were selected using MT-PCR.

MO256 Cross-species applicability of the adverse outcome pathway "deiodinase inhibition leading to impaired swim bladder inflation in zebrafish"  E. Voogd, Centre for Maritime Environmental Research; M. van der Swiel, University of Antwerp / Zebrafishlab Dept Veterinary Sciences SPHERE; H. Witters, VITO / Applied Bio & Molecular Systems; R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group); G.T. Ankley, D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; D. Knapen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences.

The adverse outcome pathway (AOP) framework can be used to help support the development of alternative testing strategies aimed at predicting adverse outcomes caused by triggering specific toxicity pathways. Previously, we developed an AOP describing how inhibition of deiodinase (DIO) enzyme activity leads to impaired swim bladder inflation in fish. Next we assessed the feasibility of selecting alternative in chemico assays targeting specific key events along the AOP and evaluate the potential of the developed biosensor and fish model for the development of in vivo endpoints. We were able to demonstrate that the in chemico dataset can be used to effectively predict effects on swim bladder inflation. For a limited number of compounds however, zebrafish responded differently than what was expected. In this presentation, we will assess these outliers by examining (1) the cross-species applicability of our AOP-based assays, (2) toxicological mechanisms other than thyroid disruption that could result in effects on swim bladder inflation. We performed in vitro DIO assays for 20 compounds using porcine, rat and fish liver homogenates to characterize similarities and differences among species. Results show that the DIO1 inhibitory potential is nearly identical between the selected species. However, a set of bisphenol A derivatives showed lower inhibition in fish compared to rodent. We performed qPCR analysis of a set of 29 genes related to thyroid metabolism and swim bladder inflation after exposing zebrafish to 4 compounds for which false negative predictions were observed. These results suggest that PFOS affects surfactant properties which could impact swim bladder inflation. In vivo studies are required to investigate to which extent the observed changes are reflected in DNA methylation and chromatin accessibility themselves, together with their correlation in in vivo models.
Zebrafish responses to the fourth-generation progestin drospirenone exposures
C. Quintanmeer, Department of Biology & CESAM - University of Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; M. Monteiro, Aveiro University / Biology
Synthetic progestins (PGs) represent an important class of active ingredients of hormonal medicines/pharmaceuticals. In addition to its endocrine activity, it is known that DRP can interfere with other biochemical processes in fish, such as induction of circadian rhythm. Thus, the present work aimed to evaluate Danio rerio early life stages responses to DRP exposures at physiological and biochemical levels. Zebrafish embryos were exposed to 0.01 – 100.0 μg/L of DRP during 96h to evaluate lethal and sublethal parameters. Survival, heartbeat, length and impairments on normal development such as malformations and hatching were evaluated in in vitro and pathological endpoints. Alterations on enzymes related with neurotransmission (acetylcholinesterase, AChE), energy production (lactate dehydrogenase, LDH) and oxidative stress (catalase, CAT and glutathione S-transferase, GST) were assessed. The oxidative damage was also assessed by alterations on lipid peroxidation levels (LPO). Exposure to DRP did not affect hatching rate, growth and development of zebrafish embryos, however, there was a decrease of a number of chemicals were identified as DRP specific toxicity were affected by DRP exposure and oxidative damage was observed. Overall, despite not having affected zebrafish early life stages apical endpoints, our study showed that DRP might exert adverse effects at both physiological and biochemical levels at concentrations similar to those found in environment for PGs. Furthermore, our results highlight the need to assess PGs toxicity at different levels of biological organization.

MO258
Fish sampling experiment as a tool for detection of in situ effects of untreated wastewaters: General stress and endocrine disruption
Dovigni, University of Novi Sad Faculty of Sciences in Biology and Ecology; B. Milčić, Petnica Science Center/Faculty of Sciences, University of Novi Sad / Department of Biology and Ecology; S. Sipos, Faculty of Sciences University of Novi Sad / Biology and Ecology; V. Kenževic, Faculty of Sciences / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX; S. Kaisarević, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology, Laboratory of Toxicology, UNT; D. Chocilović, University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX)
A direct discharge of untreated municipal wastewaters from the city of Novi Sad into the River Danube made a location a focal pollutant hotspot within the framework of FP 7 funded Solutions project. A study conducted previously at this site provided detailed chemical characterization of water samples. Relatively high concentrations of a number of chemicals were identified as DRP specific toxicity was confirmed with a battery of in vitro assays. As a follow-up, a fish caging experiment was conducted with the aim to check if the biological effects observed in vitro can be seen in situ, through a battery of biomarkers in liver and brain of caged fish. Ten specimens of common carp (Cyprinus carpio (L.), Cyprinidae), both male and female, were exposed for nine days at three sites in the River Danube: upstream, at discharge point and downstream. The study was carried out during the major discharge point of the untreated sewage into the River Danube. Certain detected chemicals are recognized causative agents of endocrine disruption and stress in general with a potential to lead to adverse physiological effects. Therefore, stress marker enzyme assays (catalase, carboxylesterase and glutathione s-transferase) were performed, and the expression of stress, endocrine disruption, immune response and autophagy related genes was analysed using qRT-PCR. Selected genes included cytochrome oxidase subunit 1 (cox1), metallothionein (mt), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor α (era), estrogen receptor β (erβ), androgen receptor (ar), cortisol receptor (cr) and vitellogenin (vtg) as endocrine disruption related genes; interleukin1β (il1b) and tumor necrosis factor (tnf) as immune response related genes, while light chain 3 (lct3) and dynin (dyn) were selected as autophagy related genes. Expression activities were higher in specimens caged at downstream locality, while catalase was lower at sewage discharge point. General stress and endocrine disruption representative genes at downstream site follow the trend of overexpression vs control (reference site), while the vtg was down-regulated at discharge point. Expression of il1b was strongly up-regulated at downstream site, while no significant difference was noted among expressions of other immune response and autophagy related genes. The results indicate induction of adaptive stress responses and endocrine disruption and are in line with the results observed in vitro.

MO259
Gene transcription ontology of hypothalamic-pituitary-thyroid axis development in early-life stage fathead minnow and zebrafish
The hypothalamic-pituitary-thyroid (HPT) axis is known to play a crucial role in the development of teleost fish. However, knowledge of endogenous transcription profiles of thyroid-related genes in developing teleosts remains fragmented. We selected two model teleost species, the fathead minnow (Pimephales promelas) and the zebrafish (Danio rerio) to describe the gene transcription ontology of the HPT-axis. Control embryos were sampled at several time points between fertilization and hatching, and larvae were sampled approximately every other day until 33 days post-fertilization. Total RNA was extracted from pooled, whole fish, and thyroid-related mRNA expression was evaluated using quantitative polymerase chain reaction (qPCR). Several thyroid-related genes in developing zebrafish were selected as autophagy related genes. Enzyme marker enzyme assays (catalase, CA and glutathione S-transferase, GST) were assessed. The oxidative damage was also assessed by alterations on lipid peroxidation levels (LPO). Exposure to DRP did not affect hatching rate, growth and development of zebrafish embryos, however, there was a decrease of a number of chemicals were identified as DRP specific toxicity were affected by DRP exposure and oxidative damage was observed. Overall, despite not having affected zebrafish early life stages apical endpoints, our study showed that DRP might exert adverse effects at both physiological and biochemical levels at concentrations similar to those found in environment for PGs. Furthermore, our results highlight the need to assess PGs toxicity at different levels of biological organization.

MO260
Skin vitellogenin and estrogen receptor as sensitive biomarkers of estrogenicity in a sub-Antarctic fish.
The fast expansion of socio-economic activities on coastal areas has increased the presence of anthropogenic pollutants from industrial and domestic sources over the last decades. Recent studies have reported the presence of many persistent organic pollutants in water, sediments and in vertebrates from Antarctic areas; however, information about their potential impact on fish physiology is still scarce. The southernmost city of the world, Ushuaia (Tierra del Fuego, Argentina), and its bays are not the exception to the decline of the environmental quality. Nototumid fish are the dominant group of fish species (Beryciformes) that inhabit the sub-Antarctic region, playing a key role in these ecosystems. The black southern cod, Patagonotothen tessellata is widespread in the Beagle Channel, lives in the intertidal zone, and possess paternal care. The aim of the present work is to validate vitellogenin (vtg) and estrogen receptor (Ren) as biomarkers of estrogenicity in skin samples of this species in order to provide a helpful tool to develop and perform environmental monitoring toxicology in marine waters, and assessing the environmental risk in places where contamination already exists. Male fish were injected with 17β-estradiol (i.p, single dose of 10 mg/kg or vehicle). Vitellogenic females were used as positive controls. Samples of skin and liver were obtained to assess vtg and ERm mRNA expression and physiological responses were studied through different endpoints: histological analysis, vtg detection in plasma samples, and sex steroid levels (estradiol (E2) and testosterone (T)). Seventy-two hours post-injection histological analysis showed normal unrestricted testis and intense cytoplasmic basophilia in hepatocytes. No vtg was detected in plasma samples of control males or before E2 injection; however, three days after treatment, males showed plasma
vtg-ir bands similar to those of females. Likewise, plasma E2 concentration in males was significantly increased but the opposite was observed in T levels. These changes were also reflected in E2/T ratio. Furthermore, E2 levels in treated males were even higher than those of females. Vtg and ERα gene expression was up-regulated both in liver and skin after E2 treatment. Potential impact in parental behavior is discussed. We conclude that vtg and ERα expression in skin are sensitive and non-harmful biomarkers of estrogrenicity in this Sub-Antarctic fish.

MO261 Thyroid disruption and its effects on neuronal development of zebrafish A. Haigis, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis ESA; C. Lefebvre, University of Alberta / Institute for Environmental Research; H. Hollert, RWTH Aachen University / Institute for Environmental Research

The endocrine disrupting effects of estrogenic compounds on humans and different species in the environment are well studied. But despite the growing numbers of patients diagnosed with thyroid disorders, thyroid hormone disruptive effects of compounds are less investigated. Furthermore, it is estimated that many substances found in our environment can influence the thyroid system and act as thyroid hormone disruptors. Thyroid hormones play a critical role in brain development and it has been shown that a lack reduces cognitive development. But the connections between thyroid disruption and developmental neurotoxicity are rarely studied and the basic mechanisms remain unknown. Because the thyroid system is well conserved among vertebrates, effects observed in humans can also be expected in wildlife. Our project focuses on the thyroid system at two different levels: on the one hand, we examine the effects of different thyroid disruptors on thyroid hormone synthesis, thyroglobulin synthesis and thyroid hormone concentrations affected survival or growth, resulting in a sub-chronic NOAEC and LOAEC of 4.5 and 10 µg/L chlorpyrifos, respectively, in fathead minnows. Samples are currently being further analyzed for molecular and physiological endpoints to gain insight into critical toxicity pathways. This study is part of the EcoToxChip project (@ecotoxchip).

MO264 Evaluation of the deleterious effect of 2 pesticides on juveniles of the zebrafish Danio rerio G. Geraldo Morales, Universidad Autonoma Metropolitana Iztapalapa / Departamento de Hidrobiologia; A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología

In this work, a screening of the toxic effect of 2 pesticides: Dichlorvos which is an organophosphorus insecticide, used for the control of ectoparasites in fish, and insecticide Imiprotrin belonging to the group of pyrethroids, used as a main component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of lipids (liperoxidation), the activity of the enzyme acetylcholinesterase (AChE) and the production of macromolecules (proteins, lipids and carbohydrates). Initially a test (96 hrs) was made, where zebrafish juveniles were exposed to 5 concentrations of pesticides (10, 1, 0.1, 0.01, 0.001, 0.0001 mg/L) to determine the 50 lethal concentration (LC50). Subsequently a bioassay with a duration of 15 days it was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC10 and LC50). The resorption of eggs show that pesticides are more toxic (LC50 = 1.67 ± 0.87 mg/L) than Dichlorvos (LC50 = 5.3 mg/L). In the sublethal bioassays it was observed that the toxicity of these xenobiotics increased with the time of exposure. The degree of liperoxidation in the imiprestorin tested varied from 64.7 to 147.5 mN Tbars mg-1 and was higher than that observed in the bioassays with Dichlorvos (22.6 to 93.8 mN Tbars mg-1). The fish exposed to Dichlorvos a decrease of 43% to 86% in the activity of the AChE enzyme was observed and from 14% to 61% in the juveniles exposed to imiprotrin. The juveniles of zebrafish that showed a decrease in the activity of the AChE greater than 35% had changes in their swimming behavior and in their feeding. The energy content of the fish exposed to pesticides decreased by 64% in the Imipresto and 81% in the Dichlorvos bioassays. The insecticides Dichlorvos and Imiprotrin are little persistent in the environment, their half-life is 5 to 8 days, but the results of this study indicate that their effects on organisms are probably irreversible.

MO265 Effects of Omeprazole on zebrafish embryos (Danio rerio) A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología; J. Salazar Hernández, Universidad Autonoma Metropolitana Iztapalapa / Biología

Omeprazole is a proton pump inhibitor, it is used for the control of gastritis, for this reason it is one of the most prescribed drug, consumed by millions of people in the world. This drug has been associated with acid rebound hypersecretion, decreased acid production, increased gastric mucosal damage and increased risk of peptic ulceration. Bioassays have been carried out in mice and rats only, for this reason in this work was made an evaluation of the toxic effects of Omeprazole in zebrafish embryos. Bioassays were performed (OECD test 236) where the embryos were exposed to 5 concentrations of the drug (200, 100, 50, 25, 12.5 mg L-1) plus a negative control, to determine the LC50 (24 hours). The embryos were subsequently exposed to the LC50, LC10 and LC5 for 96 hours to evaluate the degree of liperoxidation, by means of the evaluation of TBARS (Buege and Aust, 1978), the activity of the enzyme AChE as an indicator of effects neurotoxic (Ellman et al., 1961) and the frequency of malformations (OECD test 236). In the lethality tests, the LC50 value of 193.87 ± 18.48 mg L-1 was obtained. In the sublethal bioassays at 72 hours of exposure it was observed an increased in the degree of lipid peroxidation (52%) in embryos exposed to LC50. In the evaluation of the LC50 activity, significant differences were observed between the control and the embryos exposed to omeprazole (p < 0.05), in the concentrations LC5 and LC10 a decrease in the activity of this enzyme was observed. The percentage of inhibition of AChE varied from 9 to 66.7%. A higher frequency (22%) of deformed embryos was observed in the LC10 concentration. The results of this study showed that omeprazole has a neurotoxic and possibly genotoxic effect in sublethal concentrations in zebrafish embryos.

MO266 The neurotoxic effects of Venlafaxine on zebrafish larvae - Omics technologies in the focus of global environmental challenges M. Fenske, Fraunhofer Institute for Molecular Biology and Applied Ecology IME / Department of Ecosystem Analysis ESA; C. Di PAOLO, Institut für Umwelt- und Schlammforschung RWTH Aachen Univ / Department of Ecosystem Analysis; J. Legrodi, Vrije Universiteit Amsterdam; A. Haigis, Institute for Environmental Research RWTH Aachen University; H. Hollert, RWTH Aachen University / Institute for Environmental Research; I. Werner, Eawag, Swiss Federal Institute of Aquatic Science and Technology; M. Gundlach, Institute for Environmental Research RWTH Aachen University / Institute for Environmental Research; J. Haigis, Institute for Environmental Research RWTH Aachen University / Institute for Environmental Research

Venlafaxine is a commonly prescribed antidepressant and anxiolytic drug with a neurotoxic and possibly genotoxic effect in sublethal concentrations in zebrafish embryos. In the present study, the neurotoxic effects of Venlafaxine on zebrafish larvae were evaluated by both transcriptomics, proteomics and metabolomics. This work will be part of the EcoToxChip project (@ecotoxchip).
Fluoxetine (FLX) is among the top 100 drugs prescribed annually worldwide. This
Genetics and Morphology
T.S.
Chronic exposure to
zebrafish and rodent models
effects of the ayahuasca infusion (Banisteriopsis caapi
by ayahuasca administration in both zebras,
hallucinogenic drugs. Further research focusing on the molecular pathways affected
FST, suggesting a possible antidepressant effect. These results indicated that the
administered once by gavage to
and compares i
proteome
qPCR is being conducted. Further investigations in this project plan to include
some of the pre-selected target genes (i.e., sklp5, and
for qPCR indicated modulation of
the different effects of chem
nthe light
n1 nM, 100 nM up to 120 hpf. RNA was extracted from pooled
samples (n = 25 fish) and submitted 'in
Sybr Green quantitative real-time chain reaction (qPCR). The
based target gene selection and considering targets
involved in circadian rhythm regulation, muscle processes and responses to
abiotic stimulus. Behavioral results indicate decreased swimming distance and
increased thigmotaxis
in fish exposed, in agreement with previous own data for
continuous venlafaxine exposure. Results
PCR indicated modulated indication of some of the pre-selected target genes such as
sklp5, and currently unconfirmed
qPCR is being evaluated. Further inves-
ves for zebrafish in this paper are planned at 0 to
1000 mg/L during 96 h of exposure. The effects on locomotor activity of zebrafish
larvae were assessed using the automated video tracking system Zebrobot at 0 to
20 mg/L and after 120 and 144 hours of exposure. The ayahuasca infusion was
administered once by gavage to
rats at 1, 5 and 15 times the dose taken
during a religious ritual, and neurobehavioral effects evaluated after 2 hours in
the open field (OFT), elevated plus-maze (EPM) and forced swimming (FST) apparatus.
The LC50 of ayahuasca in zebrafish was estimated to be 236.3 mg/L. Ayahuasca exposure caused significant developmental anomalies in zebrafish embryos, mainly at the highest concentration tested, including hatching delay, loss of equilibrium, edema and accumulation of red blood cells. The behavior of embryos was also significantly affected, with a decrease in locomotor activity at the highest tested concentration. Decreased locomotion was also observed in the rats treated at the highest dose in the OFT and EPM, and a higher swimming time in the FST, suggesting a possible antidepressant effect. These results indicated that the effects of ayahuasca correlated well for zebrafish embryos and rodents, showing that zebrafish may provide a useful model to study ayahuasca and other
hallucinogenic drugs. Further research focusing on the molecular pathways affected by ayahuasca administration in both zebrafish and rat models could provide additional information on the potential of ayahuasca as an antidepressant. Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models
MO267
Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models
T.S. Andrade, Universidade de Brasília / Laboratory of Genetics and Toxicology; W. Melo Junior, University of Brasilia; R. Oliveira, State University of Campinas / SCHOOL OF TECHNOLOGY - UNICAMP; A.D. ANDRADE, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; M.L. da Silva, Universidade de Brasilia / genetic toxicology; J.A. Morais, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; C. Koppe Grisolia, University of Brasilia / Department of Genetics and Morphology; I. Domingues, University of Aveiro / CESAM Department of Biology; E.D. Caldas, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; A. Pic-Taylor, Universidade de Brasília / Laboratory of Environmental Genomics and Proteomics; Ayahuasca is a psychoactive concoction prepared with the plants Banisteriopsis caapi and Psychotria viridis and used ancestrally by Amazonian Indian populations, and recently, by Christian religions in Brazil and other countries. The present study aimed at identifying the ayahuasca effects in early fish development and compares its neurobehavioural effects in the zebrafish embryo and rat models. Toxicity tests for zebrafish were planned at 0 to
1000 mg/L during 96 h of exposure. The effects on locomotor activity of zebrafish larvae were assessed using the automated video tracking system Zebrobot at 0 to
20 mg/L and after 120 and 144 hours of exposure. The ayahuasca infusion was
administered once by gavage to
Wistar rats at 1, 5 and 15 times the dose taken
during a religious ritual, and neurobehavioral effects evaluated after 2 hours in
the open field (OFT), elevated plus-maze (EPM) and forced swimming (FST) apparatus. The LC50 of ayahuasca in zebrafish was estimated to be 236.3 mg/L. Ayahuasca exposure caused significant developmental anomalies in zebrafish embryos, mainly at the highest concentration tested, including hatching delay, loss of equilibrium, edema and accumulation of red blood cells. The behavior of embryos was also significantly affected, with a decrease in locomotor activity at the highest tested concentration. Decreased locomotion was also observed in the rats treated at the highest dose in the OFT and EPM, and a higher swimming time in the FST, suggesting a possible antidepressant effect. These results indicated that the effects of ayahuasca correlated well for zebrafish embryos and rodents, showing that zebrafish may provide a useful model to study ayahuasca and other
hallucinogenic drugs. Further research focusing on the molecular pathways affected by ayahuasca administration in both zebrafish and rat models could provide additional information on the potential of ayahuasca as an antidepressant. Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models
MO268
Chronic exposure to fluoxetine affects growth, feeding, swimming behavior and tissue organization of zebrafish.
N. de Farias, Universidade de Brasilia / Department of Genética e Morfologia; R. Oliveira, State University of Campinas / Department of Genetics and Morphology; T.S. Andrade, Universidade de Brasília / Laboratory of Genetics and Toxicology; J.M. Pinto, Universidade de Brasilia / Departamento de Genética e Morfologia Instituto de Biologia; C.K. Grisolia, Universidade de Brasil UnB / Department of Genetics and Morphology
Fluoxetine (FLX) is among the top 100 drugs prescribed annually worldwide. This
selective serotonin reuptake inhibitor is highly detected in aquatic ecosystems and has the potential to modulate levels of serotonin of non-target organisms. The present study aims to evaluate the effects of chronic exposure to FLX on fish. Zebrafish juvenile were exposed to FLX during 30 days following the OECD protocol (no. 215). The assays were performed in triplicate with six treatments of
FLX, 0; 0.01; 0.1; 1; 10 and 100 µg/L. A total of 60 fish per treatment (20 per replicate) were used. Growth and feeding behaviour were analysed at the end of the test. Histological analyses of liver followed standard H&E routine. Video recordings (10 min) were analysed for swimming behaviour by measuring the time spent by each fish in each of the layers of the aquarium (bottom: 0–5 cm, middle: 6–
10 cm and upper: 11–15 cm). Our results showed decrease in growth rate and erratic feeding behaviour at 100 µg/L. Also, in concentrations as low as 0.1 µg/L were observed morphological alterations, such as decrease of glycogen and progressive loss of hepatic architecture. The pattern of swimming behavior of fish changes significantly, fish spend more time at the upper part of the aquarium in concentration above 10 µg/L. Altogether, the present study demonstrated that chronic exposure of zebrafish to FLX can affect multiple endpoint such as growth tissue organization, feeding and swimming behaviour. These results emphasize the relevance of an integrated approach in the ecotoxicological assessment of psychiatric drugs.
MO269
Mitochondrial Disorders of Zebrafish Embryos Exposed to Individual Organochlorine Pesticides and Their Mixtures
J. Lee, Seoul National University of Science and Technology / Environmental Toxicology and Health; S. Lee, Seoul National University of Science and Technology / Environmental engineering; K. Kim, Seoul National University of Science and Technology / Environmental Engineering
Organochlorine pesticides (OCPs), prohibited compounds in the 1970s, are still being detected in human and environmental samples. Mitochondrial dysfunction caused by chemical exposure has attracted great attention on toxicological studies. We evaluated mitochondrial dysfunction in dechorinated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Chlordane (mixture), Heptachlor, Hexachlorobenzene (HCB), and beta-hexachlorocyclohexane (beta-HCH)), and their mixtures from 4 to 120 hpf (hours post-fertilization). We measured oxygen consumption rate (OCR) at the embryonic sublethal concentrations of 0.05, 0.1, and
0.5 mg/L by using Seahorse XF Extracellular Flux Analyzer at 24 hpf. The OCR results are compared with the activity of mitochondrial complex I–IV after isolating mitochondria from embryos at 48 hpf. In addition, we analyzed mRNA expression of transcription factors (i.e., PGC-alpha, Acox1, SDHA, MCAD, and CS), associated with mitochondrial metabolism, at 120 hpf. This comprehensive results could suggest the effects of OCP exposure to embryonic zebrafish model on the methodology and a set of research scheme to determine mitochondrial disorders in the exposure of individual OCPs and their mixtures.
MO270
The NeuroBox Project
J. Huis, Vrije Universiteit Amsterdam; A. Haigis, Institute for Environmental Research RWTH Aachen University; M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Spehr, B. Kampa, RWTH Aachen University; H. Hollett, RWTH Aachen University / Institute for Environmental Research
The societal impact of neurological disorders like Alzheimer’s disease or neurological deficits like autism are enormous. Using zebrafish, the effects, e.g. severe mental and physical problems, are often devastating. There is mostly no cure available and even treatments to reduce or stop the progression of the diseases are limited. The number of people diagnosed with neurological disorders is increasing. This increase cannot be explained by improved diagnostics and increased age. Exposure to neurotoxic chemicals is suspected to play a role in the development and progression of these diseases. It has been estimated that alone in Europe, exposure to solely endocrine disruptors that lead to neurological disorders, costs society €150 billion per year. This does not include costs due to exposure to known neuroactive substances like pesticides and pharmaceuticals. Currently, testing for neurotoxicity is not required within the EU (REACH) as it is not clear how to assess such effects. A new approach considering targets of chemicals and the physiological and morphological complexity of the nervous system, it is a major challenge to test all substances for their neurotoxic potential, new advanced neurotoxicity assessment strategies need to be developed to fulfill these demands. The bmbf funded project NeuroBox ((02WRS1419; coordination UBA, T. Grummert) aims to develop novel assessment strategies for neurotoxicity assessment of anthropogenic substances in water samples. The work is split over six subprojects. In our sub-project, we use zebrafish embryos to identify neurotoxic mode of actions of commonly found water contaminants. Based on our findings novel screening assays will be developed to easily screen water samples for neurotoxic effects. In combination with mouse models and clinical researchers we will also link our results to mammalian neurological diseases like ADHD and autism and neurodegeneration studies, to identify potential exposure–disease relationships. Furthermore, we will study the link between endocrine disrupting compounds and neurotoxic effects. We could see behavioral as well as metabolomics and transcriptomic changes after exposure to compounds. This
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changes were observed ad concentrations bellow any phenotypic changes could be observed. Our results so far show that assessing neurotoxicity is complex and a tiered approach covering behavioral tests in combination with OMICS techniques seem to be a cost and time efficient way.

MO271
Understanding the correlation between behavioural inter-individual variability and physiology/morphology in zebrafish larvae
K.T. Kiria, C.M. vom Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology

Background: Zebrafish are widely used in biomedical research as they offer several features such as the fully sequenced genome, availability of a wide range of mutations, generation of offspring within 96 hours post fertilization, but also small size, preserved vertebrate drug targets to a great extent. Early stages of zebrafish are called as non-protected life stages and are therefore used for testing chemicals for their toxicity as an alternative to conventional animal testing. Moreover, zebrafish larvae are amenable to test neurotoxicity and behavioural effects of chemicals as their small body size allows tracking a large number of individuals with full control over the environment. Aim: The aim of the project is to investigate behavioural inter- and intra-individual variability in zebrafish larvae as a basis to better estimate effects of chemicals on behavioural responses. Analysis of inter-individual differences might offer new insights into mechanisms of toxicity considering that every individual’s response to a chemical differs based on their genetic make-up. Hypothesis: We are testing whether inter-individual variability is constant over time and whether levels of locomotor activity correlate with physiological and morphological properties of the larvae.

Methods: At first, spontaneous locomotor activity is measured for 40 min in continuous light at different timings of the day from 5-7 days post fertilization. Heart rate, body size and other physiological properties of the same individuals are analysed at different time points. Results: From the preliminary results of the locomotor activity analysis, we could assign the larvae to three categories based on their activity levels compared to the average activity: highly active, less active and the individuals close to the average activity, which are also the ones less variable over time. To attribute this variability in the individual’s activity to its physiology and phenotype, the analysis of heart rate, length and blood flow are on going. Outlook: The variability of each individual will be taken into account to better evaluate effects of the chemicals on behavioural responses. Inter-individual differences will be explored as a source of information on mechanisms of toxicity of chemicals with unknown targets and mode of action.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (P)

MO272
Effect of iodinated X-ray contrast media in the formation of disinfection byproducts during chlorination and chloramination of water
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Iodinated X-ray contrast media (ICMs), used in medical imaging, are poorly metabolized by humans and enter wastewater. As they are incompletely removed during wastewater treatment, ICMs are released to the aquatic environment and have been detected in drinking water sources. ICMs have been identified as iodine sources that may enhance the formation of iodine-containing disinfection byproducts (DBPs) during drinking water disinfection. This work investigated the effect of different ICMs, iopamidol (IPAM), iopromide (IPR), diatrizoate (DTZ) and iohexol (IHX), in the formation of different classes of DBPs during source water disinfection by either free chlorination or chloramination. To do this, we performed large-volume (~120 L each), laboratory-controlled, headspace-free disinfection reactions with 5 μM ICM and 100 μM as Cl₂ disinfectant concentrations. The resulting DBP mixtures were chemically characterized for 21 targeted non-I-DBPs, 11 targeted I-DBPs, and non-targeted I-DBPs by means of gas chromatography coupled to low- and high-resolution mass spectrometry. The presence of ICMs in source water had no apparent effect on either the concentration or speciation of the four regulated trihalomethanes (chloroform, bromodichloromethane, chlorodibromomethane, bromoform). ICM, but not other ICMs, also enhanced the formation of aromatic acid and dibromoacetonitrile during chlorination. I-DBPs formation was slightly enhanced in the presence of ICMs, particularly in chlorinated water containing ICM, where the highest levels of I-DBPs were formed, and in chloraminated water containing IPR or IHX. The presence of DTZ did not appear to affect I-DBP formation. Non-targeted analysis of the DBP mixtures revealed the formation of novel I-DBPs in the reaction mixture of ICM and IPR, iohexol, chloridoacetonitrile, trichlorodichloroethane and several iodo-acids. Our results indicate that ICMs enhance the formation of both I-DBPs and non-iodinated DBPs when present during chlorination and that ICM, in particular, is a relevant iodine source in water undergoing chlorination or chloramination. Acknowledgments: CP acknowledges support provided by EU FP7 (No. 274379, Marie Curie IOF) and the Government of Catalonia and the COFUND programme (Marie Curie Actions, EU FP7) (2014_BP_B00064). This abstract does not represent EPA policy. This work was also partially supported by the National Science Foundation, under Award NSF1248656 to SDR.

MO273
The use of a polymer inclusion membrane for the determination of arsenate by gas-diffusion flow analysis with spectrophotometric detection
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Poly(vinylidene fluoride-co-hexafluoropropylene) as the polymer and Aliquat 336 as the extractant, for the online preconcentration and separation of As(V) in a PIM cell. The sample solution is propelled for a predetermined period of time through the PIM cell where a sample stream and an acceptor stream which is stopped during the sample passage through the PIM are combined. The As(V) preconcentration in the static acceptor solution located in the acceptor channel of the cell. The analytical procedure involves a 15 min stop-flow time and sample solution flow rate of 2.5 ml min⁻¹. After the stop-flow time the acceptor stream is re-started and As(V) is reduced to arsenite (As(III)) by merging the acceptor stream with a reagent stream containing 4 M HCl, 1% NaCl and 0.5 % ascorbic acid. This is followed by arsenic generation using another reagent stream incorporating 0.5 % NaBH₄ and 0.05 M NaOH. The generated arsenic is transported across the hydrophobic membrane of a gas-diffusion cell into a solution containing 0.02 mM KMnO₄ and 0.05 M NaOH where it is oxidised thus producing a decrease in the KMnO₄ absorbance, monitored continuously at 528 nm. Under optimal conditions the FA system has a detection limit of 2.0 ng L⁻¹, a sample throughput of 2 samples h⁻¹ and a repeatability, expressed as RSD of 1.8% (n=5, 25 μg L⁻¹) and 2.8% (n=5, 50 μg L⁻¹). The FA method has been successfully applied to the determination of As(V) in tap water in the μg L⁻¹ concentration range. <strong>References</strong> [1] Vilaescusa I, Bollinger JC. 2008. Arsenic in drinking water: sources, occurrence and health effects (a review). Rev Environ Sci Biotechnol 7:307-323. [2] Bollinger J. 2013. Related to the World Health Organization (WHO). 2011. Guidelines for drinking-water quality, 4th edition

MO274
Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers
V. P. Simoes Melia, Catalan Institute for Water Research (ICRA); J. SEVERYNS, AQUAFIN; J. Comas, L. Corominas, Catalan Institute for Water Research ICRA; J. Eavans, Eawag Swiss Federal Institute of Aquatic Science and Technology; M.G. Almeida, The University of Melbourne / School of Chemistry;

Background: The use of a polymer inclusion and separation of As(V) ion and separation of As(V) was also partially supported by the National Science Foundation, under Award FP7) (2014 BP_B00064). This abstract does not represent EPA policy. This work was also partially supported by the National Science Foundation, under Award NSF1248656 to SDR.
hydrological conditions in the Llobregat). Finally, we demonstrated that the reduction of uncertainty in the modelling process (through R&D activities) provides transparency in the decision-making process.

MO275 Calibration of passive samplers for the monitoring of drugs in French Caribbean. N. Tapié, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; D. Devault, Univ. Paris Sud / ESE UMR 8079; S. Karolak, Univ. Paris Sud, CNRS, AgroParisTech / ESE UMR 8079; Y. Levi, Univ. Paris Sud / ESE UMR 8079; H. Badzinski, University of Bordeaux

Drugs are more and more consumed worldwide (ONUDC, 2017). The French Caribbean is a hub of world cocaine trafficking and an important place of consumption of cocaine in the form of crack. The local population is particularly affected by this scourge. The consumption of illicit drugs induces the excretion of parent compounds or metabolites (markers of drugs use) in water waste, and in the end their release into aquatic environments. So, one of the ways to evaluate the local use of illicit drugs is to track drug residues in waste water treatment plants (WWTP). The present study that takes place in the SENEUR Project and explores the use of passive sampling techniques to monitor illicit drugs in WWTP. Polar Organic Chemical Integrative Samplers (POCS) were exposed in situ in a Waste Water Treatment Plant in Martinique (French Caribbean) during ten days. First an analytical development by ESI-LC/MS/MS was done in order to be able to analyze 17 compounds as markers of drug use (cocaine, heroin, amphetamine, cannabis, their main metabolites and some substitute products such as methadone) in influent samples at well below currently enforced action levels. Ionization improvements to the electrospray source eliminate the need to add organic solvent to enhance detection. Method detection limit (MDL) values in denized water were 20-60 ng/L, and MDLs in high-ionic-strength matrix are 30-60 ng/L. The calibration curves for perchlorate in high-ionic-strength matrix at 100 μg/L over the range of 125-500 ng/L using the internal standard and external methods showed good linearity with the coefficient of determination being 0.9993, and 0.9998 respectively. Single laboratory precision in drinking waters, as measured by RSD, was < 5% at concentrations >150 ng/L, perchlorate, and accuracy, was 95.6-102% for concentrations >150 ng/L, perchlorate, and 111% for concentrations < 150 ng/L perchlorate. Single laboratory precision in high-ionic-strength matrix, was < 5% at concentrations >150 ng/L, perchlorate, and accuracy, was 100-103.5% for concentrations >150 ng/L perchlorate.

MO276 Passive sampling in surface water as an immobilisation-based approach to extrapolate waste-water-related pressures and potential EQS exceedence in Luxembourg. T. Galle, Luxembourg Institute of Science and Technology; D. Pitois, M. Bayerle, Luxembourg Institute of Science and Technology List

The pressure on surface waters that is exerted by emerging pollutants depends on the use of pharmaceuticals and other compounds, which can be variable depending on the compound, thecriptors of the sewer network as well as the design and operation of the treatment plant. Several emerging compounds have mixed uses and can therefore stem from domestic as well as from industrial sources. Regulators have an interest in knowing immission situations that will probably lead to EQS exceedences without needing to monitor emerging substances in the whole hydrological network. Today, passive samplers can easily be calibrated with grab samples over all monitoring locations. The evaluation uses the conservative behaviour of carbamazepine as a tracer for (treated) wastewater input. Carbamazepine concentrations proved to be correlated to the sanitary pressure (PE/ha) in a catchment. The plotting of other compound concentrations against carbamazepine holds useful information: it shows the variability of the WWTP influents as well as elimination capacities in the catchment. According to these hypotheses recalcitrant pharmaceuticals showed a very strong and narrow linear correlations with carbamazepine while intermediately degradable compounds displayed higher variability. Complete outliers make it easy to define a threshold of 2.5 PE/ha above which EQS exceedence for diclofenac and clarithromycin is expected. This makes it easy to design a map of the river network showing the variability of the WWTP influents as well as elimination capacities in the catchment. According to these hypotheses recalcitrant pharmaceuticals showed a very strong and narrow linear correlations with carbamazepine while intermediately degradable compounds displayed higher variability. Complete outliers make it easy to define a threshold of 2.5 PE/ha above which EQS exceedence for diclofenac and clarithromycin is expected. This makes it easy to design a map of the river network showing the variability of the WWTP influents as well as elimination capacities in the catchment.
RPLC-HILIC-ToF/MS system. The analysis data were then processed following a non-target screening workflow for very polar compounds. After importing the data in STOFF-IDENT database, a proposed list of possible compounds in the samples was created. Using reference standards of the proposed compounds and MS/MS fragmentation data, it was possible to positively identify nine very polar compounds, of which six have not been reported previously in water surface samples.

MO281 Analysis of Per/Polyfluoroalkyl Substances (PFAS) in Drinking Water using LC/MS/MS to meet USEPA 537 requirements
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Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) at 70 ng/L. However, several other PFAS are also used in manufacturing and need to be monitored. To respond to this, a method was developed for the detection of PFASs in drinking water using a newly developed triple-quadrupole mass spectrometer and a modified high-performance liquid chromatography system. The USEPA has developed a method for analysis in drinking water for 14 PFAS and this method expands on that method with lower detection limits, and more QA/QC data. The water samples were extracted with solid phase extraction using a novel weak anion exchange cartridge which was optimized to achieve good recoveries for all compounds and will be presented. Several different classes of PFASs including perfluorocarboxylic acids (PFCAs), perfluorosulfonic acids (PFSA), sulfonamides (FOSA), sulfonamide acetic acids (FOSA) and others were isolated on a liquid chromatography (LC) using a reversed phase C-18 column. Since fluoropolymers are used in all LC systems, special precautions including replacing solvent lines and addition of a delay column were employed to avoid PFAS background contamination. The compounds were analyzed in negative electrospray ionization using a tandem quadrupole mass spectrometer in dynamic multiple reaction monitoring (DMRM) mode. Water samples were extracted using both an offline and automated online solid phase extraction techniques and the data was compared. All PFASs were analyzed and method performance parameters such as method detection limits, inter- and intra-day repeatability, matrix spike recoveries and other QA/QC criteria were evaluated. All recoveries were with 70-125% with %RSDs well below 15% that are needed to meet USEPA 537 requirements. Some perfluorinated sulfonates (PFSs) and perfluorooctanoic acid water and wastewater samples that were analyzed in the ng/L range. All this was done on a triple quadrupole mass spectrometer that is fully stackable with the HPLC system.

MO282 Optimisation of solid phase extraction parameters for the isolation and characterisation of benzodiazepines in wastewater
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Pharmaceutical pollutants entering the aquatic environment have become a growing environmental concern. These pharmaceuticals are unique pollutants because of their special characteristics and behaviour that cannot be simulated with other organic pollutants. The untreated wastewater effluent that contains pharmaceuticals poses a considerable threat to the aquatic ecosystem because of the negative effects of non-target organisms in the water. Recent years have seen a growing concern about the benzodiazepines, as emerging pollutants, and their effects on the aquatic environment. These compounds are nowadays widely detected in sewage and wastewater. It is important to increase the emphasis on the characteristics of the benzodiazepines in order to differentiate them from industrial chemical compounds. In this study, various solid phase extraction techniques have been employed focussing on the isolation of benzodiazepines in wastewater matrices. Emphasis is placed on the high level of differences and biodegradability of benzodiazepines. A new high performance liquid chromatography method using an LTQ Orbitrap in multiple reaction monitoring (MRM) mode, with a focus on chemicals originating from plastic materials. An optimized method was applied to pike tissue sampled upstream and downstream of the Métabetchouan’s wastewater treatment plant. The two sampling sites (upstream vs downstream) were then compared using Mass Profiler Professional Software for the presence of other unexpected contaminants. The final confirmation of various substances of interest (e.g. PFOS) was investigated through the comparison with analytical standards. Results indicated that the non-targeted workflow optimized in this study can successfully identify unexpected chemical residues in fish matrices.

MO285 Prioritising site-specific emerging contaminants in surface water based on LC-HRMS nontarget screening data
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LC-HRMS allows for the non-targeted detection of chemicals in water samples. However, the majority of the several thousand compounds detected in a typical surface water sample remains unknown. Despite we can expect further progress in HRMS-based screening approaches and compound identification, it seems unlikely that monitoring efforts will ever exceed several hundreds of compounds due to financial and time restrictions. Thus, a prioritisation is necessary, guiding decisions on the selection of compounds to monitor and to study at specific sites. Here, we propose an approach to prioritise site-specific compounds solely from LC-HRMS data based on automatically retrieved information and a rarity score derived from signal intensity and frequency of occurrence. The approach was applied to a set of 31 sites of which different subgroups from rivers and lakes, coastal waters, wastewater from the Saale and Mulde catchments in Germany. These were solid-phase extracted and analysed using LC-HRMS using an LTQ Orbitrap in ESI+ and ESI- mode. After peak picking using the MZmine 2 software, blank peaks were removed and isotopologue peaks, adduct peaks, and homologue series were detected using the R package “nontarget”. Rarity scores were calculated for all detected species as ratio of maximum and median peak intensity across all samples divided by the ratio of the number of positive detections and the total number of samples. The distribution of rarity scores was similar for ESI+ and ESI- mode, with about 80% of the detected peaks (about 31,000 in ESI+ and 15,000 in ESI- mode) showing values between 10 and 100, while roughly about 1% of peaks had values above 1000 which might be considered as a threshold level for “rare”, site-specific compounds in our dataset. The occurrence of these rare peaks at the individual sites differed considerably from 0 to 91 in ESI+ and 0 and 48 in ESI- mode. At two sites, the presence of a high number of rare peaks (48 in ESI- mode) coincided with the largest number of sulfur-containing compounds as indicated by isotopologue
Chlorination could remove some aromatic emerging contaminants (ECs) in wastewater, and the untreated (n = 6) water samples were acquired using ultra-performance liquid chromatography–quadrupole-time-of-flight mass spectrometry. By comparing the compound profiles, we evaluated the removals of aromatic ECs and discovered new signals of unknown TPs. We also characterized the molecular formulae of the TPs using database searching and isotope-pattern comparison. The parent aromatic ECs of the TPs were then traced back by spiking each aromatic EC to one 100-mL Milli-Q water. Eight of the aromatic ECs were partly removed by chlorination, where triclosan showed the highest removal (99.4%), followed by bisphenol A (72.5%). Nine of the features that were present in the chlorinated and absent in the untreated water samples were indicated as TPs. The results of database searching and isotope-pattern comparison showed that the molecular formulae of all of the nine TPs contain at least one chlorine. Each chlorinated TP was then successfully traced to one aromatic EC. The nine TPs were transformed from five aromatic ECs, including all of the four parabens and triclosan, by replacing one or two hydroxyls with chlorine atoms. The HR-MS method successfully identified nine chlorinated TPs. The results of this study demonstrated that parabens and triclosan could be transformed into more persistent, bioaccumulative, and toxic chlorinated compounds. The proposed method will be applied to the systemic identification of TPs in real water samples containing multiple ECs.

MO289
Unraveling the potential of a partial nitritation/anammox biomass towards micropollutants biodegradation
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In the past few years, anamox-based processes have attracted a lot of attention for their implementation at the mainstream line of wastewater treatment plants, due to the possibility of leading to energy autarky if combined with anaerobic digestion. However, little is known about the potential degradation of micropollutants by the microbial groups responsible of these processes and the few results available are inconclusive. This study aims to assess the degradation capability of biomass withdrawn from a partial nitritation/anoxic ammonium oxidation (PN/A) pilot plant towards five pharmaceutically active compounds (ibuprofen, sulfamethoxazole, metropol, venlafaxine and carbamazepine). Batch experiments were performed under different conditions. The results show that the TPs were degraded by different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitritation bacteria), iii) aerobic conditions with nitrite (optimal for heterotrophic bacteria) and iv) anaerobic (optimal for anoxic bacteria), v) aerobic with acetate (optimal for heterotrophic bacteria) and vi) anaerobic with acetate (optimal for heterotrophic denitrification bacteria). Ibuprofen was the most biodegradable compound, being significantly degraded under all conditions tested except heterotrophic denitrification. Sulfamethoxazole and metropol showed good percentages of removal under certain conditions (up to 70% and 62%, respectively), suggesting the specificity of different microbial groups towards the degradation of these compounds. Finally, carbamazepine and venlafaxine were hardly removed (≤ 10% in the majority of cases). Results demonstrate that the activation of different microbial groups in combination with alternating operational parameters can actually enhance the removal of some of the studied micropollutants.

MO290
Removal of pharmaceuticals in a biofilm reactor: effects of manipulating co-degradation by carbon feeding on system performance
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Pharmaceuticals are frequently found in the effluent of municipal wastewater treatment plants as conventional activated sludge systems are unable to completely remove these compounds. Biofilm reactors are a promising biotechnology to remove pharmaceuticals from treated wastewater. However, it is currently unclear whether depolluting the reactors from degradable carbon (enhancing the need of the microorganisms to go after difficult to degrade carbon) or increasing the load of organic carbon (assuming that biodegradation might be more favourable if removing pharmaceuticals. Therefore, in this study, we built up a saturated sand filter based biofilm reactor to investigate the effects of intermittent acetate feeding on the removal of indigenous pharmaceuticals from treated wastewater. Presently, the sand biofilter was operated at 12 h of hydraulic retention time (HRT). In order to prevent adaption of the species composition of the biofilm to the presence of acetate, the system was intermittently fed with influent without carbon addition or with carbon addition. Ten acetate concentration levels were tested in this study, 0, 10, 20, 30, 60, 90, 120, 150, 200 and 300 mg C/L. For each feeding condition (without or with the different carbon concentration), the system was continuously
operated for 1.5 HRTs, after which four samples were taken over 6 hours. The results showed that with the different acetate additions, the effluent oxygen concentration decreased, reaching the lowest value of 0.08 mg/L at 300 mg C/L acetate addition. However, the oxygen levels in the effluent increased always to initial conditions (4.7 mg/L) in each starving phase between the feeding phases with acetate. The acetate addition resulted in three different compound dependent removal patterns of the pharmaceuticals. Briefly, ibuprofen and isoeugenol removal was attributed to co-metabolism (enhanced with acetate). Metoprolol, iomeprol, diclofenac, propranolol and sulfamethizole removal were removed 1) at lower acetate concentrations by co-metabolic degradation dependent on aerobic turnover, and 2) at higher acetate concentrations limited by suboxic conditions. Moreover, sulfadiazine, sulfamethoxazole and trimethoprim were removed indeed efficiently acetate oxidation, which could be termed as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the bioconcentrate’s performance.

MO291 Investigating inhibitory effect of anti-inflammatory pharmaceuticals on aerobic sludge degradation

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The consumption of pharmaceuticals increases annually due to a variety of reasons involving affordability, population ageing and population growth. Due to the obstacles in monitoring all these micropollutants regularly, focusing on the priority micropollutants, i.e., the ones described above, is important. Therefore, there is still need comprehensive research to understand the toxicity mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale full-scale 10L aerobic reactor (sludge age of 5 days; 22°C) was initiated with sludge sample taken from a municipal wastewater treatment plant located in Istanbul. The culture was fed daily with a synthetic wastewater (ISO 8192) (600 mg COD/L) and primary carbon source. To assess the acute inhibitory effect, different pharmaceuticals were added as single compounds into the bioreactor in concentrations that could be considered as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the bioconcentrate’s performance.

MO293 Fate and transformation of persistent priority contaminants during potable water reuse: the challenge of producing safe water

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The elimination of opioids was significantly slowed at pH values higher than 7. The elimination of opioids was significantly slowed at pH values higher than 7. The removal of parent compounds was associated with formation of two main transformation products characterized by metabolites of 250 and 280 for tramadol and 278 and 294 for methadone. The most abundant transformation products of tramadol and methadone were tentatively identified as tramadol N-oxide and EDDP, respectively.
rate of total Cd(II) from actual wastewater was 89.25%. Furthermore, the monolayer adsorption capacity of Cd(II) based on the Langmuir model was measured to be 90 mg/g. Results were satisfactory when employing the adsorbent for removal of Cd(II) from wastewater samples. **Keywords:** Adsorption, Bioavailability, Monitoring, Wastewater.

**MO296 WATER JPI Project FRAME: A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse**


Indirect Potable Reuse (IPR) provides options to maintain sufficient water quantities for reuse while implementing—efficient and affordable strategies for IPR are needed to minimize impacts from a broad range of contaminants of environmental concern (CECs) and to preserve ecosystem services and human health. The project FRAME (A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse) is funded by the European research initiative “Water JPI (Joint Programming Initiative, Water Challenges for a smarter future).” The project is aimed at evaluating treatment processes with combined analytical, toxicological and microbiological approaches; ii) to evaluate advanced treatment options in a multiphase approach to improve removal of CECs and inactivation of pathogens; iii) to integrate the experimental results in treatment process models and groundwater models to describe the fate of CECs; iii) to provide a decision support tool for stakeholders, considering process performance and feasibility assessment for treatment scenarios. Advanced treatment options are applied in a multiple-barrier approach at laboratory and full-scale, specifically to improve the removal of CECs, inactivation of pathogens and improvement of other health-related parameters. Detailed fate studies are included to elucidate transformation pathways of CECs and to identify potential transformation products (TPs). The project involves bioanalytical and biological processes. Multi-residue analysis methods were developed for sensitive analysis of 176 CECs, including 12 PFAS. The majority of quantitation limits are in the range of 0.5 ng/L to 50 ng/L. Sorption of charged CECs onto Fe-oxides and other minerals was simulated with the goal to create a sorption model for complex soil compositions. Treatment process models using kinetic modelling of CEC and pathogen removal were developed for integration into a decision support system for stakeholders. Results at laboratory and full-scale showed that a sequential biofilter approach at pilot scale shows higher efficiency than conventional single-stage biofilters; the monitoring of full-scale secondary effluent infiltration sites reveals attenuation of certain CECs, while others require further treatment, highlighting the need for a multi-barrier approach to IPR.

**MO297 Evaluation of Rainwater collected from Concrete underground tank and other storage tanks in Owerri Imo State, Nigeria**

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ABSTRACT Due to the lack of public pipe borne water supply in Owerri municipality and its Environs in Imo State, South-Eastern Nigeria, many individuals have developed different techniques for rainwater storage for drinking and domestic use. Consequently, it is very important to evaluate the quality of rainwater harvested and stored in these different storage tanks so as to ascertain their impacts on rainwater quality. In this study, samples of harvested rainwater were collected from four different storage facilities commonly used by general populace in Owerri (Metal drum tank, concrete underground tank, PVC tank and coated basin for rainwater). The physiochemical and microbiological analysis of these rainwater samples were carried out using standard method. The trace metals in the water samples were relatively below the maximum permissible limit by WHO standard except for lead which was present at low concentration with the value (1.60±0.04mg/L) in metal drum tank based on the heavy metal content. For bacteriological analysis, the concrete underground tank recorded the presence of pseudomonas which exceeds the WHO standard stipulated for portable water. The results further explained that concrete underground tank and metal drum tank were more contaminated in terms of physiochemical and microbiological compositions. However, the study shows that harvested rainwater may not be suitable for direct drinking without treatment, but could be used for domestic purposes. **Keywords:** Harvested Rainwater, microbiological analysis, physiochemical analysis, storage facilities, trace metals

**MO298 Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health**

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Phthalates are synthetic organic chemicals commonly used as plasticisers in polyvinylchloride and as additives in personal care products. Over 2135 mg of phthalates are produced globally each year with end use products including food containers, clothing, and medical devices. Due to their high production volume and continuous release, phthalates are emerging contaminants ubiquitous in the environment. Research has shown that the widespread exposure to these chemicals has been associated with numerous adverse health effects including impaired reproductive health in males, decreased neurological development in children, cancer and obesity. As a result, some phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys). As new research emerges indicating that substitute plasticizers also contribute to adverse health effects, these restrictions are likely to increase. The present project constitutes the first application of sewage epidemiology to determine phthalate exposure in an Irish population. Phthalate levels in influent and effluent and sewage sludge (biosolids) are being monitored by GC-MS and LC-MS/MS analysis, tracking the cycle of phthalates throughout the wastewater system. Phthalate biomarkers are being analysed in influent to assess phthalate exposure. A meta-analysis on health risk data serves to relate the level of exposure to an associated risk, providing the first step in phthalate risk assessment within the Irish environment. Results will inform on the feasibility of using sewage biomarkers for future compliance monitoring. Metabolites from the following phthalates are considered for inclusion: benzylbutylphthalate (BBP), di-(2-ethylhexyl)phthalate (DEHP), diisobutylphthalate (DBP), di-butylphthalate (DOP), diisononylphthalate (DINP), and diisodecylphthalate (DIDP). This study is part of a large-scale project representing an international collaboration between three research centres Dublin City University (DCU), Arizona State University (ASU), and the Norwegian Institute for Water Research (NIVA). With support from Irish utilities, the team is assessing the sources, environmental fates and human exposure profiles of priority phthalates in Ireland. Study results on some eleven priority phthalates will be leveraged to inform risk assessments and environmental policies concerning the phthalate safety and usage.

**MO299 Phthalates and their metabolites in the environment**

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Phthalates, or phthalate esters, are esters of phthalic acid, and their chemical structure consists of one benzene ring and two ester functional groups linked with two consecutive carbons on the ring. These compounds are stable, liquid in ambient temperature, and are commonly used as plasticisers in polyvinylchloride (PVC) and phthalates have been used in the plastics industry for more than 80 years. As phthalates are so commonly used, their impact on the environment and human health has been extensively studied. Phthalates have been found to be recalcitrant, ubiquitous within the environment, and in many cases, detrimental to human and animal health. This project represents an important collaboration between three research centres (DCU, ASU, & NIVA) with support from Irish Water, Panda and Fiocchi Co., to assess the potential sources and environmental fates of priority phthalates in Ireland. This project is supported by several by studies carried out in Ireland already (DCU) and a vast array of literature in the area of priority pollutant monitoring. The impact of such study would be the analysis of these eleven phthalates from source to fate, in order to inform environmental policy on the risks posed by phthalate usage. The phthalates included in this study are Benzylbutylphthalate (BBP), Di(2-ethylhexyl)phthalate (DEHP), Diisodecylphthalate (DIDP), Diisobutylphthalate (DBP), Di-n-octylphthalate (DONP), Diisononylphthalate (DINP), and Dimethylphthalate (DMP). A selection of phthalate monooesters have also been included in this study to evaluate human exposure to phthalates. Research into the human health effects of phthalates is far from complete, while phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys), new research is emerging which indicates that substitute plasticizers have similar deleterious health effects. This research is timely as the
extent of phthalate contamination within Ireland, and the impacts on human health, are unknown.

MO300
Poly- and perfluoroalkyl substances (PFASs) in the sewage system of the Bordeaux city: high contribution of unidentified precursors of perfluorooalkyl acids

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This study proposes to identify the origin of 30 poly- and perfluoroalkyl substances (PFASs) detected in wastewater from a French city (Bordeaux Metropolis). For this purpose, 16 samples of domestic wastewaters, 10 samples of wastewaters impacted by both industrial and commercial activities were collected within the sewage network upstream typical and representative treatment plants; in addition 4 samples of runoff waters were also targeted in order to explore the input of this type of potential source. PFASs were also analyzed in the influents, the effluents, and the sludges of the 4 main wastewater treatment plants (WWTP) of Bordeaux Metropolis to quantify global inputs to the natural aquatic environment. The results highlight distinct patterns and levels of contamination between different types of samples and potential sources. Overall, wastewaters impacted by industrial inputs have the highest levels (ΣPFAS = 4.6-50.1 ng L⁻¹) with the predominance of PFOs, PFHxS, C₆-C₈ PFCA and 6:2 FTSAs. High levels of 6:2 and 10:2 FTSAs (> 10 ng L⁻¹) were found in wastewaters from the harbor area and a major industrial area. Domestic wastewaters have the highest levels of 6:2 diPAP (median concentration of 4.5 ng L⁻¹), probably related to its use in food packaging. Concerning runoff waters, the highest levels are found in the airport area with ΣPFAS of 227 ng L⁻¹. The comparison of the profiles with those found for WWTP influents using a principal component analysis made it possible to highlight the impact of the industrial and commercial discharges on the global contribution to WWTPs. It has been possible to quantify global fluxes of PFASs to the four WWTPs and they were estimated at about 14 g d⁻¹ for the sum of targeted PFASs; concerning removal in WWTPs, only the C₆-C₈ PFCA, the PFOs and their precursors with more than 8 perfluorinated carbons were shown to be partially or totally removed by the treatment processes. In addition to the targeted analysis and in order to estimate the proportion of unidentified perfluoroalkyl acid precursors, the total oxidizable precursors (TOP) assay developed by Houtz and Sedlack (2012) was applied to each of the matrices. This method, which was applied for the first time to domestic wastewaters and to WWTP sludges, revealed the presence of unidentified precursors of C₆-C₈ PFCA in all the matrices representing 32 % (in runoff water) to more than 90 % (in domestic wastewaters) of the total PFAS molar concentrations.

MO301
Antibiotics and endocrine disrupting compounds in wastewater treatment plants and in receiving water bodies around the city of Rome (Italy)


Several studies highlighted the occurrence of organic micropolutants such as pharmaceuticals residues, ingredients of personal care products and endocrine disrupting compounds (EDCs) in wastewater and downstream receiving waters. The objective of this project was to evaluate the distribution of selected current-use antibiotics and EDCs in the sewage treatment plants to be able to design and construct more efficient future plants, as well as an aid in risk assessment of these chemicals. The aim of this study was therefore to determine detailed mass flows of eleven antimicrobial compounds within three Swedish sewage treatment plants. In total, the three plants were sampled for nine days for samples representing the major flows in respective plant i.e. incoming wastewater, treated effluent, water after the primary clarifier, primary sludge, surplus sludge, digested sludge. All samples were analysed by liquid chromatography tandem mass spectrometry (LC-MS/MS). The compounds included different quaternary ammonium compounds (QACs), such as 12-BAC, 14-BAC, DDMAC, CPC and CTAB as well as other compounds such as chlorhexidine, benzotriazole, ciprofloxacin and fluoroazol. QACs and chlorhexidine were efficiently removed from the water phase (~99% reduction) but the majority remained in the digested sludge. The total yearly loads in the treated effluent in three studied plants was 29.4 kg and 2900 kg in the digested sludge. For more polar compounds such as trimethoprim and fluoroazol, about half of the amount found in the incoming sewage water was found in the treated effluent. To our knowledge this is the first detailed mass balance study for QAC and chlorhexidine reported. The study provides not only new scientific understanding but also important knowledge to e.g. wastewater treatment plant operators and law- and policy makers.

MO302
Mass flows of antimicrobial compounds in Swedish sewage treatment plants

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Antimicrobial biocides are used as disinfectants, antiseptics and preservatives to prevent unwanted microorganisms. In the same manner as antibiotics, they are entering our sewage system and passing on to the sewage treatment plants. Sewage treatment plants has been suggested as a possible high-risk environment when it comes to development of antibiotic resistant bacteria. Concerns has been raised that biocides might promote antibiotic resistance via co- and cross-resistance mechanisms. It is therefore important to quantify and understand the fate of these compounds within the sewage treatment plants to be able to design and construct more efficient future plants, as well as an aid in risk assessment of these chemicals. The aim of this study was therefore to determine detailed mass flows of eleven antimicrobial compounds within three Swedish sewage treatment plants. In total, the three plants were sampled for nine days for samples representing the major flows in respective plant i.e. incoming wastewater, treated effluent, water after the primary clarifier, primary sludge, surplus sludge, digested sludge. All samples were analysed by liquid chromatography tandem mass spectrometry (LC-MS/MS). The compounds included different quaternary ammonium compounds (QACs), such as 12-BAC, 14-BAC, DDMAC, CPC and CTAB as well as other compounds such as chlorhexidine, benzotriazole, ciprofloxacin and fluoroazol. QACs and chlorhexidine were efficiently removed from the water phase (~99% reduction) but the majority remained in the digested sludge. The total yearly loads in the treated effluent in three studied plants was 29.4 kg and 2900 kg in the digested sludge. For more polar compounds such as trimethoprim and fluoroazol, about half of the amount found in the incoming sewage water was found in the treated effluent. To our knowledge this is the first detailed mass balance study for QAC and chlorhexidine reported. The study provides not only new scientific understanding but also important knowledge to e.g. wastewater treatment plant operators and law- and policy makers.

MO303
Hormetic effects and fungicides in wastewaters of agricultural regions of Ontario

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Herbicides and fungicides are widely used in agriculture to control weeds and fungal diseases that can reduce crop yields. There is potential for these compounds to be transported from treated fields into surface waters via agricultural runoff. The objective of this project was to evaluate the distribution of selected current-use fungicides and herbicides in 5 major rivers and 13 smaller streams within regions of intense agriculture in southern Ontario, Canada. The Polar Organic Chemical Integrative Sampler (POCIS) was selected as a principal monitoring technique, although grab samples of surface waters were also collected throughout the POCIS deployment periods. The sampling rate (Rs), for each target compound, was determined in the laboratory with synthetic water over 14 days at 15°C. The sampling rates were adjusted for the influence of environmental factors (e.g. temperature, flow) by measuring the loss of Performance Reference Compounds (PRCs) spiked into POCIS deployed in the field. Extracts from POCIS and grab samples were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) or liquid chromatography coupled with Agilent 1100 HPLC. Among the six herbicide target compounds, the highest maximum concentrations were observed for atrazine (1,070 ng/L), dicamba (845 ng/L) and 2,4-D (691 ng/L). The highest maximum concentrations of fungicides were for oxazystrobin (959 ng/L), myclobutanil (86 ng/L) and boscalid (74 ng/L). The rest of the fungicides and herbicides were detected at concentrations below 60 ng/L. There was no correlation between the watersheds that had the highest levels of fungicides vs the highest levels of herbicides. This may reflect differences in crops grown across the region, or differences in the timing of application of the pesticides. Overall, this study indicated that selected current-use fungicides and herbicides are widely distributed at ng/L concentrations in agricultural watersheds in Ontario, Canada.

MO305
A Study on the Distribution and Behavior of Nonylphenol in the Suyeong River, Korea

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Nonylphenol is known, as one of Endocrine Disrupting Chemicals is the degradation product of Nonylphenol ethoxylates being used as nonionic surfactant. Nonylphenol is classified as an endocrine disrupter capable of interfering with the hormonal system of numerous organisms. In order to understand the current contamination and behavioral characteristics of Nonylphenol by measuring the concentration of Nonylphenol in the surface water in the downstream of Suyeong
River of Korea, and based on that, estimating the material balance. During the survey period, the range of Nonylphenol concentration in estuary of Suyeong River had the range of 142.0 ~ 569.6 ng/L and the average of 271.0 ng/L. The target area was divided into 3 regions to estimate the material balance of Nonylphenol in the downstream of Suyeong River. The dissolved Nonylphenol of 282.3 g/day occurred in region 1 of Suyeong River, and Nonylphenol influx load occurred in particular suspended solids of 4.5 M inhabitants living in the city of Barcelona and its metropolitan area. For this, DBP formation potential tests with chlorine were performed with the water entering each plant and produced after the individual processes carried out in each plant to treat the water. DBP mixtures were generated for each investigated matrix at two different temperatures (15°C and 25°C) and reaction times (0, 24 h, and 48 h, and also 72 h in the plant effluent) so that different scenarios in the drinking water distribution network were simulated. Six different DBP classes in total were investigated in the DBP mixes generated by means of gas chromatography coupled to mass spectrometry detection. The list included the regulated nitrosamines (NDMA), trihalomethanes (THMs), haloacetic acids (HAAs), and some anion exchange resins constitute the main source of NDMA precursors. In the context of water treatment for potable use: an update B.G. Slencu, University of Medicine and Pharmacy Grigore T. Popa Iasi / School of Pharmacy; L. Avassilăci, I.D. Morariu, Grigore T Popa University of Medicine and Pharmacy of Iasi / School of Pharmacy. Nitrosamines can form in water in specific conditions. N-nitrosodimethylamine (NDMA) is the most widely detected N-nitrosamine in drinking water which was subjected to chloramination. NDMA is also found in water subjected to disinfection with chlorine, hypochlorite or other chlorine-generating compounds, but in lower amounts. NDMA can also form through ozonization or nitrosation. Multiple mechanisms can be involved in NDMA formation: a) reaction between monochloramine or dichloramine and organic amine precursors; b) catalytic formation on activated carbon, from monochloramine or dichloramine and organic amine precursors; c) ozonization of monochloramine or dichloramine and organic amine precursors; and d) catalytic formation on carbon, from secondary amines; e) UV or sunlight photolysis of nitrite, in the presence of secondary amines. Many organic nitrogenous substances can be NDMA precursors (pharmaceuticals, substances used in cosmetics, pesticides, chelating agents, amine-based polymers, etc.), but not all can be present in significant amounts in the source water. In the context of water treatment for potable use, amine-containing coagulants and some anion exchange resins constitute the main source of NDMA precursors. Although NDMA is the most prevalent nitrosamine detected, according to the surveys conducted until now, it may account for only a minor fraction of all nitrosamines formed during chloramination. More research is required in order to establish ways to avoid NDMA and other nitrosamines formation.

MO311

Toxicology and Risk Assessment TAYER / Rey Juan Carlos University Historically, coastal and transition waters have preferentially been used for human settlement, leading to a continuous input of wastewater effluents into these habitats. Water quality monitoring of these systems, with the goal of improving their protection under the water framework directive is highly needed. The number of studies characterizing the presence of psychoactive pharmaceuticals (PAs) in coastal waters and marine biota in Spain has predominantly been limited. Our work represents the first attempt at monitoring these compounds in the Rias Baixas area (North Western Spain). This area was chosen as the location for this study due to its economic and ecological importance as a national and global leader in shellfish (especially mussels) production. In this study, the presence of 16 PAs (benzodiazepines and anxiolytics) was studied in samples of sea water and tissue from 7 economically valuable and highly consumed marine species. Samples were collected from 22 sites along the three main Rias Baixas. Fourteen out of the 16 assessed substances were detected in the water samples with venlafaxine (64%) and citalopram (41%) showing the highest detection frequencies. The highest concentrations in water were also measured for venlafaxine (291 ng/L), followed by lorazepam (95.90 ng/L) and citalopram (92.50 ng/L). Only 3 PAs (alprazolam, citalopram and venlafaxine) were present in the collected biota samples (razor clam, clam and octopus) in concentrations up to 14 ng/g d.w. (citalopram), 3 ng/g d.w. (venlafaxine) and 0.31 ng/g d.w. (alprazolam). Hazard quotients (HQ), calculated from the measured concentrations in water and available chronic aquatic toxicity data resulted in values higher than 1 (indicating elevated hazard and possible risk) for venlafaxine, citalopram, and sertraline. The venlafaxine concentration (1.5 μg/g in slaughters and 0.9 μg/g in AMFP-Fish) was firstly detected in the Ria Maire River (a tributary of the Seine River situated in the East part of Paris) at 4 sites characteristic of agricultural and urban areas. Water was also sampled for analysis to compare sites contamination. Bile is an ideal material to identify metabolites of pollutants. This biological fluid was taken directly from the gallbladder with a syringe on freshly euthanized fish and frozen for further analysis. Then, 100μL of bile was taken in 96-hole microplates and 13C-ATP (90% purity) added before extraction with milliQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMOC protocol and to find the lowest limit of detection needed. The number of contaminants potentially able to cause chronic effects in exposed organisms, as well as the presence of these compounds in biota inhabiting the area. Based on the results obtained further monitoring of venlafaxine and citalopram in coastal waters is recommended. The presence of these compounds in biota was possible thanks to the Spanish Ministry of Economy and Competitiveness FIS (PI14/00516) and the European Regional Development Fund (ERDF).

M0312 Detection of glyphosate and AMPA in fish bile from the Marne River, France
H. Blanchoud, EPHE UMR 7619; T. Ferreux, F. Alliot, EPHE / UMR Metis; A. Goutte, UMR METIS EPHE
Glyphosate is a widely used herbicide. In France, it is used during intercultural operations and to control weeds in non-agricultural areas. Glyphosate and AMPA (its main degradation product) can reach high concentrations in rivers, especially in the Seine basin including the Paris suburb (France). Although it is not bioaccumulative, the associated use of surfactants in pesticide formulations allows better assimilation in biological tissues. The aim of our study was first to develop a method to assess glyphosate and AMPA levels in biological tissues and then to determine the contamination of an freshwater fish, the European eel (Squalius cephalus) in the Marne River (a tributary of the Seine River situated in the East part of Paris) at 4 sites characteristic of agricultural and urban areas. Water was also sampled for analysis to compare sites contamination. Bile is an ideal material to identify metabolites of pollutants. This biological fluid was taken directly from the gallbladder with a syringe on freshly euthanized fish and frozen for further analysis. Then, 100μL of bile was taken in 96-hole microplates and 13C-ATP (90% purity) added before extraction with milliQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMOC–CI) and concentrated on SPE OASIS HLB cartridge (60cc) before LC MS/MS analysis. Preliminary tests were performed to establish and validate the protocol and to find the lowest limit of quantification and the best reproducibility. Results showed that glyphosate is detected in a fish sample coming from the most contaminated site by AMPA. This suggests that glyphosate is assimilated in fish and is still detectable after glyphosate has been degraded to AMPA in the water river. Glyphosate content in fish could be an indicator of environmental contamination. Further developments are needed to validate the protocol and complete the study with other organs than bile.

M0313 From source to food: following emerging pollutants
A. Garduno, The University of Nottingham; S. Pathasarathy, The University of Nottingham / Faculty of Engineering; J. Duran-Alvarez, Universidad Nacional Autónoma de México / CCADET; C. Ortiori, D. Barrett, The University of Nottingham / Faculty of Science; T.P. Dedworth, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering
The current global population growth is putting an increas...
thousands of reference spectra in one run, is written in RAD Studio (Embarcadero Delphi IDE), an object-oriented programming environment which allows easy construction of user-friendly interfaces. As an example, an imaging dataset of 196 tiles from a 208x108 pixel FPA detector (totaling 3.2 million individual spectra) can be easily managed using the software’s features. The software calculates the Pearson’s correlation coefficient between the unknown spectra and a reference spectral library. The correlation results can be further refined to define particles. The reference spectra can be easily created and uploaded to the software as a .csv file. The calculation time for comparing 3.2 million spectra to a library of 150 spectra is around 6 hours on a standard laptop. Software features include conversion from %Transmittance to Absorbance and vice versa, selection of multiple customizable spectral ranges/whole spectral range for correlation and filters for residual noise removal. The correlation results can be further refined to define particles. The boundaries. Potential MP can then be marked, measured (main axes, area) and saved. MPHunter is open source freeware. It allows a semi-automated MP identification and quantification, decreasing the time demand for the interpretation of FTIR-imaging data and increasing the data accuracy. Further improvements are ongoing to interface MPHunter to the Analysis Pipeline from Primpk et al. (2017) and use it as the searching engine.

MO316 From alpine regions to dense populated areas: A comparison of microplastic contamination between 15 rivers across Germany

M. Loeder, I. Schrank, H. Imhof, University of Bayreuth; M. Hess, LANUV NRW / Wirtschafts- und Umweltministerium; P. E. Dusek, Rhineland-Palatinate Institute for Water Management; A. Meijboom, Wageningen Marine Research; J.A. Van Franeker, Wageningen Marine Research / Institute for Marine Resources Ecosystem Studies Wageningen UR; A. Boot, SINTEF Ocean / Environmental Technology

Among marine litter, plastic waste is of growing concern, as nowadays it has become ubiquitous in the oceans. A large portion of the plastic waste is produced onshore and then enters the marine environment via water discharge to the river systems. Although, the oceans are considered as the main sink of plastic debris, recent studies Raman microscopy. Both methods identify the microplastic particles and store their coordinates for the subsequent measurements with FTIR and Raman microscopy. This spectral search can be easily created and uploaded to the software as a .csv file. The calculation time for comparing 3.2 million spectra to a library of 150 spectra is around 6 hours on a standard laptop. Software features include conversion from %Transmittance to Absorbance and vice versa, selection of multiple customizable spectral ranges/whole spectral range for correlation and filters for residual noise removal. The correlation results can be further refined to define particles. The boundaries. Potential MP can then be marked, measured (main axes, area) and saved. MPHunter is open source freeware. It allows a semi-automated MP identification and quantification, decreasing the time demand for the interpretation of FTIR-imaging data and increasing the data accuracy. Further improvements are ongoing to interface MPHunter to the Analysis Pipeline from Primpk et al. (2017) and use it as the searching engine.

MO316 From alpine regions to dense populated areas: A comparison of microplastic contamination between 15 rivers across Germany

M. Loeder, I. Schrank, H. Imhof, University of Bayreuth; M. Hess, LANUV NRW / Wirtschafts- und Umweltministerium; P. E. Dusek, Rhineland-Palatinate Institute for Water Management; A. Meijboom, Wageningen Marine Research; J.A. Van Franeker, Wageningen Marine Research / Institute for Marine Resources Ecosystem Studies Wageningen UR; A. Boot, SINTEF Ocean / Environmental Technology

Among marine litter, plastic waste is of growing concern, as nowadays it has become ubiquitous in the oceans. A large portion of the plastic waste is produced onshore and then enters the marine environment via water discharge to the river systems. Although, the oceans are considered as the main sink of plastic debris, recent studies also reported on the contamination of freshwater ecosystems with microplastics. Therefore, freshwater ecosystems do not only act as a source of plastic particles for the oceans, they also act, at least temporarily, as a sink. This may come along with all the associated harmful consequences that have been reported previously for marine ecosystems. Nevertheless, there is a considerable gap of knowledge about the impact and contamination of freshwater ecosystems with plastic particles. The lack of harmonized methods for microplastics sampling and detection hamper the comparability of data on concentrations and the composition of synthetic polymers in the freshwater environment. We compared microplastic contamination down to 20µm between 15 rivers across Germany, by the use of a harmonized sampling, sample processing and sample analysis (FTIR) currently verified by the JPI Oceans project BASEMAN. Results show a high variability between rivers and due to the lower size fraction measured relatively high concentrations compared to the few studies conducted in surface waters of freshwater ecosystems so far. Further, our data may shed light on major pathways and sources of microplastics in freshwater ecosystems. (M. Loeder, I. Schrank and H. Imhof contributed equally to the work as first co-authors).

MO317 Analytical approach for the identification and quantification of microplastic particles in environment samples by particle analysis in combination with FTIR and Raman microscopy

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The detection of microplastic particles in an environment sample in the wide range from 1 µm to 5 mm nearly quantitatively in a reasonable time is a challenging mission. This task should start with well defined sampling procedures and sampling locations. Next task is the sample preparation procedure to remove organic and inorganic parts in such a manner, that the microplastic particles will not be destroyed. A further important point is the subsequent loss free transport to an analytical lab and the use of blind samples from the sampling location through all steps until the lab. Starting from this point our poster describes the following principle steps to identify microplastics by means of FTIR and Raman microscopy. This is particularly the case for polyethylene and polystyrene microplastic samples subjected to different types of simulated environmental weathering (UV, additive leaching, abrasion, biodegradation) in the lab. An unattended analysis approach was first used to classify pristine and environmental MP samples. Multivariate tools were then applied to classify the samples based on the global pyGC-MS derived composition of the polymers, and to compare pristine materials with samples from the environment. The technique shows promise where manual techniques fail or have difficulty due to the lack of visual resolution of chromatographic peaks with important diagnostic mass spectral features.

MO319 Marine Microplastic: Production and characterisation of realistic test materials for studying ecosystem impacts

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Reported studies investigating the possible effects of plastic litter on marine biota have almost exclusively utilised pristine plastic materials that are homogeneous in polymer type, shape and size. This is particularly the case for microplastics (marine litter < 5mm), as collecting samples of such material from the marine environment in quantities sufficient for use in laboratory impacts studies is simply not feasible. Crucially, weathered plastics collected from the marine environment show considerable physical and chemical differences to pristine and post-production consumer plastics. In the current study, we describe the preparation and characterisation of a more environmentally realistic marine litter-derived microplastic reference material (≤3 mm) for use in fate and effects studies. Weathered marine plastic litter (351 items) was collected from the coast of the island of Texel (The Netherlands) and carefully identified and categorised (fibre-based, packaging, foam, plastic boxes and jerry cans, bottles, gloves and miscellaneous plastic materials). The particles were then sieved to obtain samples from 1-5 mm followed by sub-sampling of the collected material, which contained 9 different polymer types. The macroplastic material was sub-sampled and subjected to a cryo-milling and sieving process to create the microplastic reference material. To confirm that the original macroplastic polymer distribution was mirrored in the generated microplastic sample, it was subjected to ATR-FTIR and Raman microscopy and residual pyrolysis mass spectrometry. The original polymer composition of the marine litter was determined using pyrograms with associated mass spectra (m/z range 50-600) were obtained for a range of the most common polymer types, as well as for polyethylene and polystyrene microplastic samples subjected to different types of simulated environmental weathering (UV, additive leaching, abrasion, biodegradation) in the lab. An unattended analysis approach was first used to classify pristine and environmental MP samples. Multivariate tools were then applied to classify the samples based on the global pyGC-MS derived composition of the polymers, and to compare pristine materials with samples from the environment. The technique shows promise where manual techniques fail or have difficulty due to the lack of visual resolution of chromatographic peaks with important diagnostic mass spectral features.

MO318 Using pyrolysis GC-MS in combination with multivariate tools to identify and differentiate polymer type and weathering of microplastics

T. Borstle, L. Sorensen, K. Almaas, SINTEF Ocean / Environmental Technology; M.O. Høyes, Norwegian University of Science and Technology; O. Brakstad, A. Booth, SINTEF Ocean / Environmental Technology

Pyrolysis gas chromatography coupled to mass spectrometry (pyGC-MS) is a promising tool for identifying and quantifying trace amounts of microplastic (MP) in environmental samples. For pristine plastic samples, it has been demonstrated that polymer type and additive chemicals can be elucidated from the obtained pyrograms and their underlying mass spectra. As a proof of principle, a further study investigated a) automated MP identification and quantification, the technical integration, the number of accumulations, the magnification of the objectives and the lateral resolution, which influence the results concerning measurement time and locating and identification of mainly smaller particles will be discussed.
MO320 Optimization of the preparation of standards of high density polyethylene microplastics and quantification techniques by st erosopic and confocal microscopy.
J. Kim, Incheon National University; J. Perales, CAC YTMAR University of Cadiz / Department of Environmental Technologies; E. Rojo-Nieto, Helmholz centre for environmental research - UFZ / Department of Cell Toxicology; J. Gonzalez-Leal, University of Cadiz.
A non-complex procedure has been developed for preparing HDPE microplastic s as standard for microplastic determination in sediments. Always keeping environmental considerations in mind, the tests were carried out in several brands were studied in order to identify those that could provide a clear spectrum for HDPE using Raman spectroscopy (considering that Raman spectroscopy is sensitive to those additive and pigment chemicals in microplastics that interfere with the identification of polymer types). Red caps from a popular brand of mineral water were selected as the raw material as their spectrum was easily comparable with those provided in the literature for HDPE. The large pieces of plastics were converted into microplastics by using a conventional machining process, i.e., a drill with a sandpaper implement (Dremel 300, 13 mm-60 grain size sandpaper). With this method, several sequential sessions of the machining processes were carried out in order to avoid changes in the physical properties of the plastics that would result from temperature increase due to due to prolonged friction. After the machining, the obtained HDPE particles were sieved using ethanol (96%) through two different mesh sizes until a final standard ranging from 0.1 to 0.850 mm size was achieved. This range was selected as it is relevant in biota ingestion risk as well as is appropriate for visual counting using microscopes. The standard HDPE microplastics used in all the extraction experiments were the same. It was thoroughly mixed previously to spiking in order to avoid differences in the distribution of standard HDPE plastic particles. HDPE microplastics were suspended in ethanol 96% and shook using a magnetic stirrer. An effective method for determining the particle distribution of microplastics is microscopy. In this work, two types of quantification using microscopy were used and compared: optical microscopy by visual sorting (Leica ICC50 HD, 4x lens, using a mesh for counting with sections of 3x3 mm prepared for this study) and, confocal microscopy (Zeta Instruments, model Zeta 300). The last one, included object detection algorithms (Mathematica 10) which only not allows quantification of plastic particles but also their classification into size groups.

MO321 First Report of Microplastics in Pacific-side Arctic Ocean
H. Lee, S. Kim, Incheon National University / Department of Marine Science; S. Kang, Korea Polar Research Institute / Division of Polar Ocean Science
The Arctic is one of the pristine areas that are sensitive to global environmental changes and have a relatively low environmental pollution. However, Arctic is already affected by floating microplastics (MPs) according to previous studies (38-234 pieces/m2 for ice and 1.34 pieces/m2 in the Atlantic arctic polar water). Previous research on the Arctic has concentrated on the waters associated with the Atlantic Ocean (for example, the Barent Sea), while the Arctic Sea (e.g., the Chukchi sea, East Siberian sea, etc.) linked to the Bering strait has never been studied. This area can be particularly important because it links Asian marginal seas and the Pacific Ocean, which is regarded as a global hot-pot of MPs input to the ocean. We conduct annual surveillance in every summer since 2016 using a Korean icebreaker (RV ARAON) to identify the presence, distribution, fate and effect of MPs in the Arctic Ocean connected with the Bering Sea. This is first result for the Pacific ocean-side polar region investigated in 2016 (Aug./05-21/2016) & 2017 (Aug./06-25/2017) ARAON Expeditions. Here, we present the results observed in some media including seawater (surface and subsurface water), sea-ice core, and snow. Seawater samples were collected by manta-trawl net (200 mm mesh, n=12) for surface water, bongo net (330 mm; n=16) for subsurface water, sea ice (n=27) by ice-corers, and snow (n=6). MPs were detected in all samples with average concentrations of 0.41 n/m3 (surface water in 2016), 0.55 n/m3 (subsurface water in 2016), and 12.90 n/L (in sea-ice core). We are progressing the analysis for sea-ice core, and the results will be published next year. It is generally known that plastics are light and float, therefore they could be enriched on the water surface layer. However, MPs abundance observed in the bongo net (subsurface water) was similar to that of the manta nets (surface water), which can be a strong evidence of the possible sinking of MPs into the deep water of the Arctic Ocean. On the other hand, the sea ice’s contamination level was observed to be several tens of thousands higher than seawater. This indicates the necessity of further study on the trapping mechanism in the freezing process and the effect on the environmental change. The results of this study can be applied to further study on their major origins & mass balance of MPs in the Arctic Ocean, and contribution of MPs to environmental changes in the Arctic Ocean.

MO322 Analysing microplastics in samples of terrestrial systems
The occurrence of microplastics (MP), i.e. solid synthetic polymer particles between few micrometres up to five millimetres, in marine and limnic water systems, is already manifold documented. On the contrary, less is known about the occurrence and the fate of MP in terrestrial systems. In the ongoing discussion about general monitoring of plastic pathways in the environment this is a gap, because MP in terrestrial environments could influence the quality of soil, but might be also relevant for the final transport of plastics into the aquatic environment, e.g. via erosion. In this regard, one critical point is the lack of harmonized or standardized protocols. The matrix of soils is usually more complex than the matrix of aqueous samples. For a first assessment of a potential exposure situation, the determination of the quantity of plastics in soils is essential. The goal of this work is the development of a systematic protocol for sampling, sampling pre-treatment and analysis of MP in terrestrial samples, which ends up in a fast, quantitative method. Up to now, various studies about the analysis of MP at beaches, in marine sediment and along rivers are available. In these studies, as sample pre-treatment density separation techniques were used to reduce the inorganic matrix. In some cases, a chemical oxidation step to minimize the organic matrix is additionally carried out. FTIR or Raman spectroscopy were used to analyse the sample with enriched concentrations of MP. Using these techniques, only small proportions of inserted samples were analysed. Similar investigations techniques were used for terrestrial samples. The few existing studies investigated sewage sludge, compost fertilization or areas of intensive utilization of plastics foils in agriculture or from industrial production processes. The goal of this study is to identify the contamination of microplastic remaining in seawaters. This indicates that sea-salt may be a monitoring media for global seawater contamination of microplastics. The purposes of this study are 1) to identify the contamination of microplastic in commercial table salt products sold worldwide, 2) to elucidate any relationship of microplastic consumption between sea-salt and seawater and, 3) to calculate the human exposure of microplastics resulting from the consumption of commercially available salt products. To do this, we purchased and analyzed the salt samples in 17 countries (8 countries in Asia, 7 in Europe, 1 in Africa and 1 in North America) in four continents. Each salt sample was selected in consideration of the salt production area, production method, and salt consumption pattern in each country. Total 37 salt samples were analyzed, including sea salt, lake salt, and rock salt. Each sample was duplicated (n = 2) and two blank samples were analyzed for each batch to check contamination during the analysis. Size, color, polymer, and shape of each microplastic was determined under microscopic and spectroscopic analysis (FTIR). Thousands of microplastics were detected per 1 kg of the salt samples of this study, and the predominant forms were fragment and fiber, which were frequently detected in the order of PP > PE > PET. Significant correlation was observed between microplastic discharge rate via the rivers near the sea-salt production and microplastic contamination in the sea-salt. After further analysis, human exposure, characteristics of microplastic distribution, and application of sea-salt as an alternative monitoring medium will be announced.

MO323 Biodegradability of pristine and weathered car tire rubber using different inocula
P. Polese, Technical University of Denmark / DTU / DTU Environment; T. Ahonen, Technical University of Denmark / DTU / Department of Environmental Engineering; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment
Car tire wear is estimated to represent a major fraction of microplastic pollution in the environment. Rubber particles are transported by transport and road runoff, thereby reaching soils and wastewater treatment systems. Information on their occurrence, fate and degradability in environmental and engineered systems is limited yet crucial to determine their persistence and potential risks associated to their exposure. In this study, we assessed the biodegradability of car tire rubber (90-125 µm) under controlled laboratory-scale conditions. Standardized batch tests (OECD 301 and ISO 14851) were used to determine complete mineralization under
aerobic conditions of pristine and UV-weathered tire rubber in the presence of three different microbial inocula, i.e. activated sludge, soil particles and soil subterranean. Acetate and poly(D,L-lactide-co-glycolide) (PLGA) were used as positive controls in terms of readily degradable substrate and degradable plastic material, respectively. Pristine and weathered rubber exhibited low but measurable biodegradation levels in the presence of activated sludge (3.8-7.6% ThOD) and soil particles (1.0-7.8% ThOD), while no biodegradation was observed when using soil particles as inoculum. Accelerated UV weathering and higher biomass concentration was found to increase the biodegradability by activated sludge. Interestingly, increased response in terms of oxygen consumption was observed with acetate as co-substrate, indicating improved rubber degradability in the presence of a readily degradable carbon source. PLGA exhibited limited biodegradability and no degradation was observed when using both synthetic and natural sorbents. Increased porosity and roughness on rubber surfaces over the course of the experiments, seemingly indicating degradation via surface colonization. Overall, ready biodegradability tests proved suitable to obtain information on degradation of car tire rubber. This study provides first evidence of their degradability, especially for weathered rubber in the presence of a co-substrate, which should be considered for future studies. The results of this study can be used to develop efficient methods to remove rubber from natural environments.

**MO235**

Evaluating sorption properties of tire materials using poly-parametric linear free-energy relationships (ppLER)  
M. Wehrhahn, University of Vienna / Environmental Geosciences; T. Huffer, T. Hofmann, University of Vienna / Department of Environmental Geosciences  
Tire materials are common representatives of microplastics in the environment. They are introduced on the one hand as tire wear, an abrasion product, which reaches the environment via road runoff. They are one of the most popular construction materials and are widely distributed for example on turf fields. It was recently shown that tire materials are a substantial share (66%) on waste that is introduced into the environment as microplastic particles. Tires generally consist of a mixture of polymers (40-60%), mostly styrene butadiene rubber (SBR). These elastomers are compounded with carbon black or silica as reinforcing agent (20-35%), oils (15-20%) as softeners and extenders as well as vulcanization chemicals (e.g., zinc oxide and sulphur (1-2%)). Although tire materials are known to pose the risk of leaching toxic substances, they are one of the most popular construction materials and are widely distributed for example in the application of artificial inshore areas. For recycling purposes, rubber is decomposed by means of pyrolysis and volatile organics are used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aqueous environment. Currently, little is known about the ecotoxicological impacts of MR. The present study was to conceived to determine the toxicity of tire rubber particles to Hyalella azteca, an established freshwater model organism, over acute and chronic exposures, and to delineate particle effects from those of the leachate. The acute toxicity (48 h) of MR particles compared to the MR leachate show similar LC50s (3426±172 particles/mL for MR and 3628±672 particles/mL for leachate), but significant differences are found at LC10 and LC90, suggesting that at low particle concentration the leachate is more important, but at high concentrations the particle may act to deliver chemicals in vivo following ingestion. The results of the 21 day study showed that mortality, reproductive output (neonate production) and net growth were significantly impacted at the higher exposure concentrations of MR. MR is an emergent contaminant of concern that is similar but distint to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

**MO236**

Particle toxicity in the daggerblade grass shrimp (Palaemonetes pugio): microrized tire wear particles and microplastics  
L. J. Hailey, Roskilde University / Science and Environment; A. Palmquist, Roskilde University / Department of Science and Environment; K. Kumpmann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment  
Nanoparticle ingestion of rubber particles and their effects and chemical characteristics of a pristine tire with previous data from a worn tire of same make and model. Effects are assessed as changes in survival, growth and reproduction and both the effects of rubber particles and rubber leachate are investigated with the aim of determining whether there are particle effects and/or if the mode up uptake of chemicals leached from tire influences effects observed in the leachate. The chemical characteristics of both pristine and worn tire particles are quantified by GCMS. The preliminary results indicate that, surprisingly, pristine tire both as particles and leachate is much more toxic than worn tire in acute tests. Although rubber particles have been detected in the aquatic environment the potential environmental impacts of this contamination are largely unknown. Hyalella azteca is an ecologically relevant freshwater amphipod that is also a well-established model organism in ecotoxicology. This study aims to investigate the acute and chronic effects of worn car tire rubber particles on Hyalella azteca, an ecotoxicological model organism. We aimed to determine effects and chemical characteristics of a pristine tire with previous data from a worn tire of same make and model. Effects are assessed as changes in survival, growth and reproduction and both the effects of rubber particles and rubber leachate are investigated for whether there are particle effects and/or if the mode up uptake of chemicals leached from tire influences effects observed in the leachate. The chemical characteristics of both pristine and worn tire particles are quantified by GCMS. The preliminary results indicate that, surprisingly, pristine tire both as particles and leachate is much more toxic than worn tire in acute tests. Although the main source of MR undoubtedly is worn tire, these results point toward further ecotoxicological testing of tire coatings used during manufacturing. Results from this ongoing study will be presented and discussed in relation to the microparticle debate.

**MO239**

Applying nuclear techniques to study the biokinetics and toxicodynamics of
The occurrence of plastics was found in a total of 76.6% of the analysed mussels from the Norwegian environment, with the overall average plastic load being 1.85 particles gram⁻¹ w.w (ranging from 0 – 24.45) and with the highest values found in mussels from the Barents Sea. Microplastics consisted of fibers (85 %), fragments (12 %) and films and foams (4 %) and most particles were < 1mm, with the most dominant polymer group being semi-synthetic materials (rayon/viscose). Based on literature and this current study, Mytilus spp. seems to be a promising sentinel species to monitor pollution of the smallest waterborne microplastics in the marine environment. However, for the method to be fully quantitative, improvements/further investigations are needed e.g. same sized mussels from each site to be exposed in the same environmental conditions, as well as to be kept under similar conditions within populations. Furthermore, the presence of semi-synthetic materials in the marine environment needs to be further investigation as well as their potential effects on biota.

**Mercury Biogeoosciences - Fate, Effects and Policy (P)**

**MO333**

*Influence of biofilm composition on mercury bioaccumulation*


In aquatic systems, the dominant lifestyle of microorganisms (bacteria and microalgae) is to live together interlocked in exopolymeric substances (EPS), rather than as separate cells. Besides their involvement in several biogeochemical processes, biofilms are sites of accumulation and transformations of mercury (Hg). Their natural assemblage of heterotroph and autotroph microorganisms makes them an important entry of Hg into aquatic food webs. The objective of the present study is thus to better understand the mechanistic processes that control Hg accumulation in biofilms and we focused on the elucidation of the role of biofilm composition on the kinetics of Hg uptake. For that end, two couples of biofilms were exposed to Hg (100 pM, precisely measured) using microcosms. The first couple of biofilms was obtained using different times of colonisation e.g. 85 and 127 days whereas the second couple (bottom/surface biofilms) was obtained owed to different colonisation depth in the Versoix River (CH). Prior Hg exposure, biofilm biomass and microbial composition (cholorophyll content and qPCR abundance of 16S rRNA gene) were determined as well as EPS and protein EPS (chitin content). The main water quality parameters (pH, concentrations of dissolved organic carbon, Hg, anion and cation) of the exposure media were also analysed. Accumulation of total Hg and non-extractable Hg (determined after a 24h washing step) in biofilms were measured at different step times (t < 24 h) to model non-extractable Hg uptake kinetics using a non-linear pseudo first order one-compartment model. In each biofilm, non-extractable Hg accumulation was very rapid, within minutes of exposure. The uptake rate constant of the younger biofilm was measured to be 10 times higher than that of the older biofilm. That same ratio was also obtained between the bottom and the surface biofilms. Except for the older biofilm, Hg accumulation reached a plateau at ~6 Hg exposure. A decrease in the EPS thiol concentration was observed in the bottom biofilm upon Hg exposure, suggesting a change in Hg bioavailability in the microorganism environment living in that biofilm. Our study demonstrated that biofilm microbial and EPS composition as well as thickness influence Hg uptake by microorganisms living in biofilms.

**MO334**

*Gaseous elemental mercury concentration and diurnal evasional fluxes from the water-air interface in coastal environments of the northern Adriatic Sea*

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Among pollutants widespread in the environment, mercury (Hg) is still recognised for its toxicity, mobility and bioaccumulation potential. In coastal areas the presence of this element generates conflicts with important resources of profitable value such as fisheries and aquaculture. The Marano and Grado Lagoon (Adriatic Sea) experienced a double Hg impact. The first is due to the mining activity especially in the 19th century and the second is the result of discharge of a chlor-alkali plant effluents. Fish farming is a relevant activity in these areas. In the Marano Lagoon, Hg has been detected in various species to monitor pollution of the smallest waterborne microplastics in the marine environment. Due to several methodological differences between studies (e.g. sample collection, samples processing, identification of microplastics such as visual ID, detection limit and chemical verification of polymers) comparability can be challenging. When looking at spatial trends it is necessary to use comparable methods. Several studies have found microplastics in *Mytilus spp.* and a recent study found accumulating levels of microplastics in mussels compared to the surrounding waters. In this study, a total of 252 mussels were investigated from 13 different sites along the Norwegian coast by using KOH digestion followed by visual ID and µFTIR. The occurrence of plastics was found in a total of 76.6% of the analysed mussels from the Norwegian environment, with the overall average plastic load being 1.85 particles gram⁻¹ w.w (ranging from 0 – 24.45) and with the highest values found in mussels from the Barents Sea. Microplastics consisted of fibers (85 %), fragments (12 %) and films and foams (4 %) and most particles were < 1mm, with the most dominant polymer group being semi-synthetic materials (rayon/viscose). Based on literature and this current study, *Mytilus spp.* seems to be a promising sentinel species to monitor pollution of the smallest waterborne microplastics in the marine environment. However, for the method to be fully quantitative, improvements/further investigations are needed e.g. same sized mussels from each site to be exposed in the same environmental conditions, as well as to be kept under similar conditions within populations. Furthermore, the presence of semi-synthetic materials in the marine environment needs to be further investigation as well as their potential effects on biota.
historical activity covering 14% of the total lagoon area. Recently, one fish farm was long-term monitored in order to understand the role of the sediment-water interface in recycling Hg and to estimate benthic fluxes and Hg mobility in the water column. An important further step toward a better comprehension of the Hg biogeochemical cycling in the lagoon environment, is represented by the estimate of its evasional fluxes, as gaseous elemental mercury (GEM), at the water-air interface. A continuous passive micro samplers (IOMS - Lumes-Ra 915+) has been used to measure GEM and to estimate the diurnal evasion flux at the water-air interface during three seasonal campaigns in four selected sites: two in a lagoon fish farm, one in the open lagoon environment highly impacted by Hg mining activities and the last one in an uncontaminated area of the Gulf of Trieste, the Bay of Piran (Slovenia). Accomplished to these measures, the study was also used to estimate background level of dissolved mercury in the environment as well as trends in levels of mercury and mercury compounds observed in biotic media and vulnerable populations on the basis of available scientific, environmental, technical, financial and economic information. UN Environment in close collaboration with Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IAI) and WHO implemented a UN Environment - Global Environmental Facility (GEF) project entitled “Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury”, from late 2014. The project contributes to scientific knowledge for development of effectiveness evaluation mechanism. The main aim of the project was to harmonize approaches for mercury monitoring and to strengthen the capacity of monitoring of mercury in the environment as well as in trends of mercury and mercury compounds across the water-air interface; however, determination of the fundamental rate constants and mechanisms of these reactions in freshwaters are still areas that require more research. In particular, the total amount of photoreducible mercury is emerging as a key variable that requires more exploration. Here, we review the progress of our group has made in this field over the past 10 years; we present rate constants as well as the inter-annual changes of photoreduction and photooxidation rates would be significantly different in lake water. Another hypothesis was that the amount of mercury available for reaction with solar radiation (i.e. reduction of Hg(II) to gaseous Hg(0)) in surface waters would significantly change over a summer. A Luzchem photo-reactor was used to irradiate 200 mL water samples in quartz beakers continuously exposed to ultraviolet radiation for 24 h with concurrent Hg(0) analysis to derive pseudo-first order gross reduction rate constants and batch experiments were used to derive net reduction rates (and gross photoproduction rates by difference). This research provides the first quantitative measurements of gross photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

M0337 Mercury Photo-reduction and Total Photoreducible Mercury Dynamics in the Lakes of Keijmukuj National Park, Nova Scotia N.J. O'Driscoll, Acadia University / Department of Earth and Environmental Science; T. Chrestensen, E. V. Ver, Nova Scotia Department of Natural Resources; S. Klapstein, E. Mann, Acadia University Photo-reduction and photo-oxidation are fundamental mechanisms controlling mercury volatilization and accumulation in freshwaters. In all surface waters dissolved gaseous mercury (DGM) is produced as a net result of the reduction of reducible mercury, which is believed to be primarily divalent mercury (Hg(II)) bound to specific carbonate-based ligands and the oxidation of thiol mercury (Hg(0)). These two processes control the amount of DGM available for evasion across the water-air interface; however, determination of the fundamental rate constants and mechanisms of these reactions in freshwaters are still areas that require more research. In particular, the total amount of photoreducible mercury is emerging as a key variable that requires more exploration. Here, we review the progress of our group has made in this field over the past 10 years; we present rate constants as well as the inter-annual changes of photoreduction and photooxidation rates would be significantly different in lake water. Another hypothesis was that the amount of mercury available for reaction with solar radiation (i.e. reduction of Hg(II) to gaseous Hg(0)) in surface waters would significantly change over a summer. A Luzchem photo-reactor was used to irradiate 200 mL water samples in quartz beakers continuously exposed to ultraviolet radiation for 24 h with concurrent Hg(0) analysis to derive pseudo-first order gross reduction rate constants and batch experiments were used to derive net reduction rates (and gross photoproduction rates by difference). This research provides the first quantitative measurements of gross photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

M0338 Influence of Avian Biovectors on Mercury Speciation in a Wetland J. Kickbusch, Acadia University / Biology; M.L. Mallory, Acadia University / Biology; J. Agnew, Acadia University / Biology; M. Burek, Acadia University / Engineering; S. Klapstein, Acadia University / Earth & Environmental Science; A. Loder, Acadia University; N.M. Hill, Fern Hill; N.J. O'Driscoll, Acadia University / Department of Earth and Environmental Science Mercury is a persistent and bioaccumulative chemical that is present in many remote environments due to its ability to be transported long distances in the atmosphere, and to be deposited far from the original source (Sunderland and Chnorra 2000). Wetland ecosystems are important “hot spots” for mercury in eastern Canada, providing anoxic environmental conditions that promote the bacterial methylation of mercury. Methyl mercury is the most biologically available form of mercury and the form which biomagnifies in food webs (Gochfeld 2003). The avian biovector is considered as a well-known contaminant of wetlands including freshwaters – including mercury – and nutrients, which may indirectly affect metal speciation (Choy et al. 2010). The site study thus far, Big Meadow Bog (Brier Island, Nova Scotia, Canada) has a history of ditching in the 1950s, which changed hydrology significantly, resulting in colonization by 3000 pairs of herring gulls (Larus argentatus) in the 1980s. To quantify changes in mercury mobilization and speciation in response to this biotic stress has been found to change the water quality. For both river, water, sediments, bryophytes, biofilms and fish (Salmo trutta fario) were collected. Water was analysed for its physico-chemical parameters (pH, concentrations of dissolved organic carbon (DOC), anions, cations, metals, including Hg). Sediments were also analysed for their metal concentrations as well as for their composition. Finally, metal concentrations were also measured in both biofilms and bryophytes (total and soluble) as well as in fish (gills, muscle, gonads and liver). Results indicated that there were two species that are moderately hard in summer to very hard water in winter and are characterized by a very low DOC concentrations (~ 0.2 mg L⁻¹). Sediments are mainly composed of coarse sand (~ 95%) with very low organic matter (0.5 – 2%). In summer, when the river flow was at its highest, Hg concentrations in sediment and bryophytes are low, with no observable differences between up- and downstream sites. However, fish gills, liver, and muscle demonstrated more elevated Hg concentrations downstream of sites compared to upstream ones. In fall as well as in early-spring, when the flow decreased by more than half as compared to that of summer, Hg concentration in the water column is lower but remains high in bryophytes, as well as Hg concentrations are in accordance with fish and Hg data demonstrated the Hg increase downstream the landfills. However, no oxidative stress and impairments are observed in fish. The present study confirms the need to address all compartments to properly assess the water quality of an aquatic system and therefore to understand potential impact of landfills and industrial sites on freshwater ecosystems.
MO339 Organohalogen and mercury residues in fish from the Western Mediterranean Sea: concentrations, bioaccumulation and dietary exposure

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Organochlorine compounds (OCs) and mercury (Hg) have diverse deleterious health effects and are persistent in the environment. They tend to bioaccumulate and biomagnify along the food chain. Diet is the major source for the incorporation of these pollutants into humans, especially trough consumption of fish. This research focuses on the presence of OCs, total mercury (THg) and methylmercury (MeHg) in lean fish from the Western Mediterranean Sea. Determinant factors of these concentrations such as trophic level and weight of fish have been studied. The estimated weekly intake (EWI) from the Spanish population of these pollutants has been assessed. Samples were collected between March 2015 and August 2016. Most of them were from Balearic Islands (Majorca n=67, Menorca n=17, and Ibiza n=18) and the rest of the samples were from Tunisia (n=2) and Egypt (n=1). Additional fish samples were collected from the Atlantic Ocean, in front of Senegal (n=4) and Mauritania (n=10) coasts for the comparison. The OCs levels found in fish were similar or lower than in other previous studies. In contrast, 15% of the most frequently fish species consumed by the Spanish population had Hg concentrations above the maximum level set forth by the European Union MRL for human consumption. The concentrations of OCs and Hg between trophic levels have been compared. Except for HeCB, the values were higher in the upper trophic level with statistically significant differences for ΣDDTs and ΣPCBs (p<0.05). The relationship between fish weight and pollutant concentrations were also studied. A positive relation between Hg concentrations and weight was found (R²=0.58; p-value=0.001). This trend was not observed for any other OC. The concentrations found in dusky grouper from the Mediterranean Sea and Atlantic Ocean were also compared. The former group presented higher levels for ΣDDTs, ΣPCBs and Hg (p<0.05). The estimated weekly intake of OCs were well below the reported Tolerable Intakes. However, for Spanish population that only consume Mediterranean fish, the estimated weekly intake for Hg (4.42 µg/kg bw) exceeded the provisional tolerable weekly intake (PTWI) for adults and children set to protect the environment, aquatic plants and animals. The sources of mercury in fish, every year the population of this area is exposed to more than 1500g tonnes per year of these commercial fish species are disclassified) as well as supporting significant tourism, recreational fishing industries. The Lakes area has been subject to several contaminant monitoring investigations over the last 45 years that have identified sediment and soil samples with detectable mercury concentrations, often exceeding screening levels set to protect the environment, aquatic plants and animals. The sources of mercury to the Lakes have been identified as having anthropogenic origins. Historic sources are gold mining and wastewater discharges from a paper mill. Ongoing sources of mercury include emissions from coal-fired power plants in the Latrobe Valley to the east of the Lakes and wood smoke from fireplaces and planned burns. This study, conducted in 2015, aimed to determine if the concentrations of mercury in black bream had increased over time, and whether or not existing dietary advice issued nationally by Food Standards Australia New Zealand for the protection of consumer health against the effects of mercury in seafood, was appropriate for fish sourced from the Lakes. Three previous studies investigated the concentrations of mercury in fish from the Lakes from 1980 to 1998. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of mercury in fish caught in the Lakes area over time with fish caught in the previous years. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than a result of increasing availability of mercury to fish.


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Fish consumption is linked to the prevention of some human diseases, especially represent a unique aquatic ecosystem of significant ecological significance (Ramsar classified) as well as supporting significant tourism, recreational and commercial fishing industries. The Lakes area has been subject to several contaminant monitoring investigations over the last 45 years that have identified sediment and soil samples with detectable mercury concentrations, often exceeding screening levels set to protect the environment, aquatic plants and animals. The sources of mercury to the Lakes have been identified as having anthropogenic origins. Historic sources are gold mining and wastewater discharges from a paper mill. Ongoing sources of mercury include emissions from coal-fired power plants in the Latrobe Valley to the east of the Lakes and wood smoke from fireplaces and planned burns. This study, conducted in 2015, aimed to determine if the concentrations of mercury in black bream had increased over time, and whether or not existing dietary advice issued nationally by Food Standards Australia New Zealand for the protection of consumer health against the effects of mercury in seafood, was appropriate for fish sourced from the Lakes. Three previous studies investigated the concentrations of mercury in fish from the Lakes from 1980 to 1998. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of mercury in fish caught in the Lakes area over time with fish caught in the previous years. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than a result of increasing availability of mercury to fish.

MO341 Mercury concentrations in black meat from the Gippsland Lakes, Victoria, Australia.

L. Melo, EPA Victoria / EPA Victoria; S. Balshaw, Department of Health and Human Services; R. Goudey, EPA Victoria

The Gippsland Lakes are a coastal lakes system in eastern Victoria, Australia. They represent a unique aquatic ecosystem of significant ecological significance (Ramsar classified) as well as supporting significant tourism, recreational and commercial fishing industries. The Lakes area has been subject to several contaminant monitoring investigations over the last 45 years that have identified sediment and soil samples with detectable mercury concentrations, often exceeding screening levels set to protect the environment, aquatic plants and animals. The sources of mercury to the Lakes have been identified as having anthropogenic origins. Historic sources are gold mining and wastewater discharges from a paper mill. Ongoing sources of mercury include emissions from coal-fired power plants in the Latrobe Valley to the east of the Lakes and wood smoke from fireplaces and planned burns. This study, conducted in 2015, aimed to determine if the concentrations of mercury in black bream had increased over time, and whether or not existing dietary advice issued nationally by Food Standards Australia New Zealand for the protection of consumer health against the effects of mercury in seafood, was appropriate for fish sourced from the Lakes. Three previous studies investigated the concentrations of mercury in fish from the Lakes from 1980 to 1998. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of mercury in fish caught in the Lakes area over time with fish caught in the previous years. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than a result of increasing availability of mercury to fish.

MO342 Mercury health risks due to the substitution of fish meat with shark meat.

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A previous three years study of mercury content in a variety of edible marine fish from Mexico City’s fish market (Central de Abasto) to evaluate the risk due to non-intentional shark meat ingestion. Samples were bought in the fish market as fish for ceviche, quesadillas or soup, economical fillet, battered or breaded, or deep-fried from sea bass, redfish, tilapia, red snapper and other species. Chondrichthys universal oligonucleotides in PCR were used to analyze the quality of samples. 777 samples were applied to obtain information regarding fish consumption habits, portion sizes and other characteristics of the population of the Mexico City metropolitan area. Shark mercury content was taken from the previous study. Hg average daily dose, lifetime average daily dose and total dose were calculated for two concentrations: 0.13 ppm (adults) and 0.19 ppm (infants). Health risk was calculated using USEPA equations. Of the 52 “fish samples” analyzed 61.53% were identified as sharks of the following species: Leopard (Galeocerdo cuvier), Common sawshark (Pristis pristis cirratus), Goblin (Mitsukurina owstoni), nurse (Ginglymostoma cirratum), whale shark (Rhincodon typus), scalloped hammerhead (Sphyrna lewini), daggersnose (Isogomphodon oxyrhynchus), silky (Carcharhinus falciformis). With regards to the health risk, when considering the lowest Hg concentration, children may eat only one 188 g portion/month, while fertile women and older people, two 190 g portions/month and men up to five 260 g portions/month. When considering the average Hg concentration, the number of portions/month is drastically reduced to less than one portion/month. If the amount of portions described before are respected, the calculated risk for babies was 0.83 but significantly reduced later in life if the lowest Hg concentration is considered. However, when calculating the risk with the average Hg concentration the risk quotient was always above 1 and up to 7.2 for babies. In conclusion there is a health risk when eating fish that cannot be identified, so people must buy whole fish to secure their identity and authorities should implement a monitoring program to penalize the sale of shark meat as fish meat.
MeHg was also affected by the presence of green tea, decreasing the amount of 31% (yellowfin tuna) and 8% (Atlantic wreckfish). The bioaccessibility of species presenting a bioaccessibility below 50%. Moreover, after grilling, results demonstrated that total Hg/MeHg concentration in seafood does not reflect through seafood contamination with high trophic level marine species, raising human health risk. Environmental gradients of sulfate in lakes in the surrounding area with distance from the Giant Mine in Yellowknife, NW. Mercury (Hg) is a global pollutant that bioaccumulates in aquatic and terrestrial organisms, with continuous enrichment among the trophic levels. Concentrations of Hg were significantly higher in Paranaguá (0.02 to 5.8 mg kg⁻¹) than in Cananéia (0.02 to 0.9 mg kg⁻¹), with maximum values in marine mammals, followed by invertebrates benthic and fish. Through linear regressions between Hg and δ²⁷⁰¹⁷o, positive correlations were observed only in Paranaguá, but they were not significant, which indicates a trend of biomagnification of this element. Such a behavior is expected since this estuary suffers greater pressure from anthropic activities than Cananéia, and presented similar values to highly degraded Brazilian estuaries, such as Santos Bay (SP) and Guanabara Bay (RJ). The results showed a current panorama of the trophic distribution of Hg in these estuaries being a useful tool in environmental monitoring and coastal management in regions of great ecological importance.

MO344 Biological and Geochemical Drivers of Mercury Toxicity in Yellowknife, NWT, Canada
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C.1. - Mercury (Hg) is a global pollutant that bioaccumulates in aquatic and terrestrial foodwebs as monomethylmercury (MMHg). Microbial activity is the main driver of MMHg production, with sulfate reducing bacteria being a major contributor. The roasting of arsenopyrite at Giant Mine in Yellowknife, NWT, has created strong environmental gradients of sulfate in lakes in the surrounding area with distance from the mine. Whereas total Hg levels remain constant with increasing distance from the mine, δ²⁷⁰¹⁷o is lower in lakes with relative proximity to the stack. We hypothesized that high sulfate in lakes near the mine may be responsible for elevated MMHg concentrations in those same areas. To test our hypothesis, we sampled water and sediments from lakes spanning a range of distances from the Giant Mine. We determine simultaneous methylation and demethylation rates using stable isotope analysis and characterized the microbial community in response to pH changes from anthropogenic activities than Cananéia, and presented similar values to highly degraded Brazilian estuaries, such as Santos Bay (SP) and Guanabara Bay (RJ). The results showed a current panorama of the trophic distribution of Hg in these estuaries being a useful tool in environmental monitoring and coastal management in regions of great ecological importance.

MO345 Use of green tea to reduce mercury and methylmercury bioaccessibility in raw and cooked fish
V.F. Barbosa, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Seafood Upgrading; P. Anacleto, Instituto Português do Mar e da Atmosfera (IPMA) / Division of Aquaculture and Seafood Upgrading; R. Alves, King Abdullah University of Science and Technology (KAUST); A. Maulvain, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seafood Upgrading.; F. Fogoça, Embrapa; T. Langerholc, Faculty of Agriculture and Life Sciences, University of Maribor; A. Marques, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Seafood Upgrading. Human exposure to mercury (Hg) and methylmercury (MeHg) increases in diets rich in high trophic level marine species, resulting in deleterious effects through food chains. Nevertheless, the overall concentration of Hg and MeHg detected in seafood does not always reflect the amount that will be available for absorption by human intestinal epithelium after the digestion process. On the other hand, several studies have highlighted the health benefits attributed to green tea consumption and their potential effects on reduction of bioaccessibility of contaminants in food. In this context, the aim of the present study was to assess the effect of green tea in Hg and MeHg bioaccessibility in raw and cooked marine fish species. Results demonstrated that total Hg/MeHg concentration in seafood does not reflect the bioaccessible fraction. Hg bioaccessibility in raw samples ranged between 60% (yellowfin tuna and black scabbardfish) and 37% (European cong), with most species presenting a bioaccessibility below 50%. Moreover, after grilling, Hg/MeHg bioaccessibility significantly decreased in all species, ranged between 31% (yellowfin tuna) and 8% (Atlantic wreckfish). The bioaccessibility of Hg and MeHg was also affected by the presence of green tea, decreasing the amount of these contaminants. In raw samples with tea, Hg bioaccessibility ranged between 47% (black scabbardfish) and 26% (swordfish); and between 18% (yellowfin tuna) and 7% (swordfish) after grilling. Green tea significantly decreased Hg/MeHg bioaccessibility in raw samples of yellowfin tuna, common smooth-hound and swordfish, as well as in grilled yellowfin tuna, common smooth-hound, Atlantic wreckfish and blue shark. Bioaccessibility variability may be explained by changes in the chemical composition of species during grilling and green tea catechins bioavailability, once they are relatively unstable. This work clearly reveals that green tea is able to reduce Hg and MeHg bioaccessibility, leading to lower the risks associated with seafood consumption. Nevertheless, a better understanding of green tea bioaccessibility is needed, and how its protective effect affects other contaminants. Such information is certainly useful to help consumers to wisely select their food, and to enable food safety authorities to integrate this information in risk assessment and communication activities.

MO346 Importance of a tidal flat-saltmarsh system as a source-sink of mercury in a contaminated coastal lagoon environment (northern Adriatic Sea)
E. Petranich, University of Trieste / Dept. of Mathematics & Geosciences; L. Tarabilla, University of Trieste; S. Covelli, Dipartimento di Matematica e Geoscienze / Dept. of Mathematics and Geosciences; A. Acquavita, ARPA FVG; E. Pavoni, University of Trieste
Saltmarshes are important constituents of marine-coastal transitional environments that provide several services to the ecosystem. Due to anthropogenic activities, several contaminants are increasingly introduced into these environments where are deposited through runoffs, and can accumulate from anthropogenic activities than Cananéia, and presented similar values to highly degraded Brazilian estuaries, such as Santos Bay (SP) and Guanabara Bay (RJ). The results showed a current panorama of the trophic distribution of Hg in these estuaries being a useful tool in environmental monitoring and coastal management in regions of great ecological importance.

MO347 Main sources of mercury releases in Armenia
A. Aleksanyan, Hazardous Substances & Waste Policy Division / Head of Division; A. Saghatelyan, Center for Ecological-Nonoosch Studies NAS RA; G. Tepanosyan, Center for Ecological-Nonoosch Studies NAS RA / Environmental geochemistry department
National mercury releases inventory was done with the use of UNEP’s “Toolkit for identification and quantification of mercury releases” (January 2015)”. The following main sources of mercury releases in the Republic of Armenia were identified: - Coal combustion and other coal use - Combustion of other types natural fuels (petrol, kerosene, diesel, liquid petroleum gas) - Natural gas - Zinc concentrate production - Copper concentrate production - Black copper converter production - Pig iron production - Lead - Mercury - Scrap metal recycling - Other intentional use (luminous/fluorescent lamps, thermostats, manometers and gauges, etc.) - Use and disposal of other products - Production of recycled metals - Waste incineration and open waste burning The key mercury releases here are releases to air (the atmosphere), to water (freshwater bodies, including via waste water systems), to land, to general waste, and to sectors specific waste treatment. An additional output pathway is “by-products and impurities” which designate mercury flows back into the market with by-products and products where mercury does not play an intentional role. In 2016-2017 studies were carried out in Vanadzor City of Armenia: at the territory of Chemical Combine and at the adjacent area. The highest content of mercury (3.3 mg / kg) has been recorded in dust of air sampled from the industrial area of the Combine. In air samples from adjacent urban area mercury content made 0.027-3.3 mg / kg.
hispidula in the upper Felidia river basin, Colombia

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The upper basin of the Felidia River, located in the Parátones National Park of Cali, Colombia, is subject to different anthropogenic stresses, such as hydropower, the product of illegal mining. Using a direct quantification method (EPA 7473), it was studied the variation of total mercury (HgT) in the samples of the riparian fern Thelypteris hispidula, sediments and water in three streams: El Socorro, El Roberto and El Pato, during the dry season, dry-rain transition and rainy season. Using non-parametric statistics (Kruskal Wallis), significant differences were found in the HgT of the samples. The highest water < 0.05), accumulating mainly in El Socorro. The HgT in the root of the plants presented differences in distinct sampling times (p = 0.005), increasing in the rainy season. The Spearman’s bivariate correlations showed that the dynamics of HgT accumulation in the root, is directly related to the concentration of HgT in the stem (r = 0.918, p = 0.000) and leaves (r = 0.900, p = 0.000). It was also evidenced that the accumulation of HgT in the root, is influenced by the concentration of HgT in the sediments (r = 0.704, p = 0.001). This results demonstrate the environmental effects caused by mining activities in protected areas in Colombia.

MO349 Temporal integration of diurnal variations of metals and mercury concentrations by passive sampling method in a highly polluted site on the Deûle River, northern France

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Due to several metallurgical plants along the river, the Deûle River is a highly polluted site in the northern France. Previous studies showed that sediments are polluted with Cd, Pb, Zn and Hg (Vdovic et al., 2006). Moreover, intense fluvial traffic generates regular resuspension of sediments leading to diurnal variations of metals concentrations in the dissolved and particulate phases. This was previously highlighted by in situ voltammetry approaches allowing to measure Pb, Zn and Cd with a high frequency data acquisition (Superville et al., 2014). However, these measurements could not be performed for Hg with such probes, while previous field deployment of DGT (Diffusive gradient in Thin films) passive sampler suggested such variations. Indeed, time weighed average concentrations were 20 times higher (20 ng/L) than those measured in grab samples (1 ng/L). Thus, a field campaign was conducted over 15 days to assess diurnal variations of metals and Hg concentrations (dissolved, particulate and labile phases) related to fluvial traffic in the Deûle River, in the city of Aubry, downstream a metallurgical plant (Umicore). During the first week, DGT were exposed and grab samples were collected with a high sampling frequency (night and day). Then, a second set of DGT were exposed during the second week. The resuspension of particles and anoxic sediment caused by fluvial traffic was highlighted by the simultaneous increase of ammonium (NH4+) and Mn in the pore water of the control (from 1.09 to 3.34 mg/L). The analysis of metals and Hg in SPM showed increases of Pb, Zn, Hg and Cd concentrations in the particulate phase. The analysis of particulate Hg after two different filtrations at two cut-off points (0.45 and 0.70 µm) showed that particulate Hg re-suspended by fluvial traffic was mostly in the coarse fraction of SPM. Furthermore, the increase of SPM concentrations was related with an increase in dissolved Hg concentrations. These results suggest that when the anoxic sediment is remobilized by barge traffic, particles could be oxidized inducing a release of Hg. Moreover, since changes in redox conditions could also induce modifications in Hg speciation, further analysis will be carried out to measure Hg0 and CHHg.

Finally, the interpretation of DGT measurements will show how well DGT integrate variations of inorganic contaminants concentrations during the exposure period.

MO350 The effect of activated carbon amendment on mercury methylation in contaminated sediment

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The conversion of elemental and inorganic mercury (Hg) to monomethyl mercury (MeHg) has been widely studied due to MeHg being more bioavailable, bioaccumulative and toxic to humans than the inorganic and elemental species. The net production of MeHg is controlled by both mercury methylation and demethylation, and a range of factors affects both processes. Sediments are known sites for MeHg production, as they are sinks for Hg, they have suitable red-ox conditions, a presence of methylating bacteria and more. Activated carbon has been much explored as a remediation tool for contaminated sediments: The carbon can immobilize contaminants, inhibiting the release to the water column and uptake in biota. Studies have shown that activated carbon also sorb Hg-species, but the mechanisms of how a carbon amendment affects the processes of Hg-methylation in contaminated sediments is not well understood. A lab trial was set up with sediment from two sites in Norway: The Gunnekefjord (GF) and Bergen Harbour (BH) – two heavily contaminated localities by mercury pollution. Bulk concentrations were 25.5 and 9.5 mg/kg total mercury (THg) for GF and BH respectively. Two treatments were investigated: Activated anthracite char (AC) and activated biochar (BC). Treatments were set up for time series of 0, 1, 3 and 6 months in sealed glass jars, stored dark at room temperature. At each time series sediment and pore water was sampled. Activated carbon amendment caused a reduction of Hg-methylation in sediments compared to the controls, as pore water samples showed a reduced concentration of MeHg. However, such variations were not always statistically significant. The BC treatment caused an initial 55% reduction of MeHg but after 1, 3 and 6 months the reduction is >99% compared to the control. In the BH sample, there was no increase of the initial 2.1 ng/L MeHg in the pore water of the control during the 6 months of the experiment. Both AC and BC treatments however, reduced MeHg in the pore water by >50%. Pore water MeHg-concentrations measured by DGT were similar to concentrations in extracted pore water, indicating that pore water MeHg is available for uptake.

MO351 Bayesian Human Health Risk Assessment of Almadén Mining Area

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Almadén, with the largest and richest known mercury deposits, is located in the southwest of Ciudad Real (Spain) with a population of 5,657 inhabitants (2016). This area can be considered one of the most affected by mercury in the world, both by its natural origin and by anthropogenic pollution since there are indications that the cinnabar mines of this region have been mined without interruption since before the fourth century BC until 2002. A probabilistic human health risk assessment has been carried out in order to establish whether mercury contamination of Almadén endangers human health. Two thousand samples were collected from the area (lettuce, beans, tomato, onion, pepper, potato, cucumber and zucchini were analyzed) are not acceptable. The results show that the human health risks obtained by ingestion of fish bought in local markets and vegetables grown in contaminated areas are not acceptable. The difficulty of the probabilistic analysis is that it is not always easy to obtain distribution functions for the different parameters of a given population, being frequent to use the literature to be able to complete the necessary information. To address this problem, Bayesian statistics have been used. Thanks to that, a combination between stablished density functions (a priori distributions) and data collected at the study site can be carried out. In this way, the exposure variables are better defined by a posteriori-determined distributions that allow a better estimation of the risk. The results show that the human health risks obtained by ingestion of fish bought in local markets and vegetables grown in the area (lettuce, beans, tomato, onion, pepper, potato, cucumber and zucchini were analyzed) are not acceptable. The methodology to be used in the context of the Minamata Convention includes a ban on new mercury mines, an end to the trade of mercury-containing products, the waste incineration directive 2000/76/EC and the Minamata Convention adopted in 2013 which is a global treaty to protect human health and the environment from the adverse effects of Hg. In addition to its elemental form Hg
also exists in oxidised forms (i.e. Hg(II)) that are reactive and can be transformed into organic Hg species such as methylmercury (MeHg), the most toxic Hg species and the one most prone to bioaccumulation in aquatic systems. Half of atmospheric Hg emissions are of natural origin whilst the rest are of anthropogenic sources, primarily from fossil fuel burning and other high temperature industrial processes (cement clinker production, waste incineration, ore roasting, steel production). Knowledge of Hg speciation both in air and in stack gas emissions is critical when validating models for predicting Hg emissions, transport, deposition and fate at the European level as well as on a global scale. Therefore, atmospheric Hg isotopic signatures that can be used to trace the origin and fate of atmospheric Hg also need methodological support and development. The overall goal of the EMPIR – MercOx project (Oct 17 – Sept 20) is to develop SI traceable measurements, for monitoring and control of mercury and its different species in gas emission sources and in the atmosphere. The project will achieve significant improvements in the measurement comparability and uncertainty of Hg measurement results. Currently, traceable calibration methods only exist for elemental mercury, but such measurements are also needed for oxidised Hg species in order to meet the requirements of EU regulation and the implementation of the Minamata Convention. The development of reliable and direct Hg(II) measurement techniques and reliable and traceable Hg(II) standards is needed to solve the traceability problem that currently exists in the measurement of total mercury (Hg(0)) and oxidised Hg concentrations originating from different Hg sources. Furthermore, methods for measuring oxidised Hg and for accurately comparing the Hg(0) concentration in generated elemental and oxidised Hg reference standards are required, as well as issue/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used for the on-line measurement of Hg under field conditions and a comparison of Hg species inter-conversion.

**MO354**

**PBTK/TD assessment of mercury (Hg(II)) accumulation in freshwater tilapia species**

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Waterborne and dietborne exposures of freshwater fish to inorganic mercury (Hg(0)) affect their growth and reproduction. However, a mechanistic model to predict the impact of Hg(II) on freshwater fish is lacking. The purpose of this study is to develop a physiologically-based toxicokinetic/toxicodynamic (PBTK/TD) model to assess bioaccumulation of Hg(II) in freshwater tilapia. A PBTK model consisted of six interested compartments can be constructed including blood, gill, liver, muscle, intestine and ovary. The compartments’ physiological and biochemical parameters can be estimated from published tilapia-related studies. The partition coefficients were estimated for each tissue or organ based on the experimental data by dividing Hg burden in tissues of that in blood at specific days after Hg(II) exposure. A series of experimental data were analyzed to reconstruct the dose-response profiles describing the relationships between tissue/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used to describe the dose-response relationships. Here we showed that tissue/organ burdens would reach equilibrium before 180 days of exposure in all six rivers. Among all exposed tissues/organs, kidney had the highest internal exposure doses of Hg(II) ranging from 0.0208 – 0.1348 μg g⁻¹ ww. In contrast, muscle had the lowest internal exposure doses of 0.0001 – 0.0003 μg g⁻¹ ww(Hg(II)), indicating that Hg(II) in muscle could be well below the threshold required at risk for human consumption based on regulation from Taiwan FDA. The highest accumulative internal dose of Hg(II) was in gill of 0.0115 (95% CI: 0.0007 – 0.1907). The effective Hg(II) burden in tissue/organ at 50% mortality for liver, gill, and muscle were 10.410 ± 1.047, 6.307 ± 0.756, and 2.839 ± 0.575 μg g⁻¹ ww, respectively. A fair quantitative agreement between model predictions and experimental data was also reached. Sensitivity analysis indicated that the amount of Hg accumulated in tilapia whole body was most influenced by sediment uptake rate, indicating that sedimentborne Hg exposure was the most influential factor on accumulation of Hg species that is bottom-feeding fish. We suggest that more dose-response data of sublethal and chronic effects are required to improve future risk assessment in a mechanistic and practical way. In a broader way, our model can be applied to predict continuously chronic Hg accumulation in fish that are deemed safe for human consumption.

**MO355**

**Mercury in fish, fish intake and fish consumption recommendation**

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Fish consumption is recognized as an important component in the human diet, due to the high-quality protein content and n-3 fatty acids, however, it is also considered the main route of mercury (Hg) exposure from ingestion of contaminated seafood. Hg is released into the environment by natural and anthropogenic sources and is recognized as a pollutant of high importance, due its high degree of toxicity, persistence and bioaccumulative properties. Since exposure to mercury poses human health at risk, the Food and Agriculture Organization (FAO)/World Health Organization (WHO), Joint Expert Committee on Food Additives (JECFA) and also by the United States Environmental Protection Agency (USEPA) have been established reference doses (RfD) or “Provisional Tolerable Weekly Intake” (PTWI), in order to minimize that risks. JECFA established a PTWI for MeHg of 1.6 μg kg⁻¹ bw⁻¹ week⁻¹, whereas USEPA pointed a lower value of MeHg intake, setting the RfD at 0.1 μg kg⁻¹ bw⁻¹ day⁻¹ (equivalent to 0.7 μg kg⁻¹ bw⁻¹ week⁻¹ ).

Recently (2012), PTWI suggested by JECFA for MeHg was revised by the Environmental Food Safety Authority (EFSA) to 1.3 μg MeHg kg⁻¹ bw⁻¹ week⁻¹. This study, presents a brief review of the Hg concentration present in the muscle of commercially valuable fish species caught near the mid-Atlantic ridge (Azores Archipelago) where fish consumption relative highly (….) and compares these Hg concentration with the maximum levels of Hg for certain contaminants in foods established by the European community, evaluates the human exposure to Hg, using the Hg concentration quantified in scalp hair and related with fish consumption using a food frequency questionnaire and establishes isocurves pointing the maximum number of fishmeal per week without exceeding the MeHg RfD (USEPA RfD), by combining number of meals (per week), amount of fish ingested (by meal) and levels of MeHg in fish. The Hg concentration found in the hair indicates that individuals with higher fish consumption per week generally have higher concentrations of Hg and in order to meet the USA dietary guidelines, which recommend a consumption of 227g; only fish with MeHg concentrations below 0.34 μg g⁻¹ could be selected to be consumed so that the PTWI established by JECFA would not be exceeded, despite the concentration of 0.5 μg g⁻¹ (“exception list”) is allowed for fish consumption.

**Mechanistic effect modelling for risk assessment: applications, use in a regulatory context and future directions**

**MO356**

**Ring-test of different implementations of the General Unified Threshold Model of Survival (GUTS)**

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The additional information and insight gained through the application of toxicokinetic-toxicodynamic modelling can strengthen the environmental risk assessment of chemicals in consumer products or plant protection products. For the endpoint survival the most suitable and powerful tool is currently the General Unified Threshold Model of Survival (GUTS), which consists of two complimentary models: GUTS-SD (stochastic death) and GUTS-IT (individual tolerance). In order to ease the use of GUTS and increase trust and acceptability we recently carried out a ring-test of eleven different implementations of GUTS. The frequency of erroneous results due to programming errors and less appropriate settings for numerical solvers or parameter search and convergence algorithms indicated that user training and experience is key. However after correction of user errors all software implementations resulted in comparable and similar results. Estimated parameter values generally agreed well and the implementations returned similar results in scenario tests for pesticide risk assessment. We suggest that new users and new GUTS implementations should be trained using this ring-test and refer to these results as benchmark. Any new user should run the ring test exercises and improve their modelling techniques until they achieve comparable results. Standardisation of typical use cases could also help to reduce sources of error such as corresponding, user-friendly, robust GUTS software. This software could reduce sources of error by restricting user-choice to only those options suitable and relevant for the regulatory risk assessment under consideration.

**MO357**

**Feeding impairment in fish explained by a TK-TD model**

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In current environmental risk assessment (ERA), plant protection products (PPPs) are tested on a diversity of standard test species for harmful effects. Recent developments in mechanistic effect modelling provide the possibility to extrapolate results from standard studies for non-target species or under tested ecological scenarios or exposure situations, which will improve the quality of ERA as well as saving time and resources. Toxicokinetic-toxicodynamic (TKTD) models for lethal effects have already proven the ability to identify patterns in effects across compounds and species. The Dynamic Energy Budget (DEB) theory may have the potential to provide a general modelling framework for sublethal effects. Models based on DEB theory have been used in ecotoxicology for decades, and these models are currently under discussion as standard approach for risk refinement at the level of tier-2. Models based on DEB theory allow for mechanistic interpretation of effects on feeding, energy expenditure, growth and reproduction. The same modelling framework can be used for all organisms, which is crucial for across - species extrapolation of effects. Many compounds, especially those that target the nervous system, act on the ability of the organisms to feed or assimilate energy. Thus,
predicting effects on feeding and assimilation is a crucial characteristic for a TKTD model to predict sublethal effects in the context of ERA. We present here the results of the i-ERA project (integrated ERA) on the responses to low food conditions / feeding impairment in four fish species (rainbow trout, fathead minnow, zebra fish and medaka). We tested the DEB model for predicting organism level responses of juveniles (rainbow trout) and adults (all others) under low food conditions. We find that in both the juvenile and adult conditions, fish do not change their metabolism compared to the standard DEB model. This indicates that the model can be used in ERA for the four fish species analyzed here to predict effects of compounds that act on feeding inhibition without any adaptation. The differences in the organism-level response to low food conditions / feeding impairment between the four species can be explained by differences in their model parameters. The standard DEB model can be extended to account for effects of prolonged low food conditions. We suggest the DEB model adaptations needed in such case, and discuss how the model can be used in risk assessments for weight-of-evidence in tier-1 and tier-2 as suggested by EFSA.

**M0358**

TK-TD modelling as an additional line of evidence in the risk assessment for aquatic macrophytes chlorotoluron as a case study

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To assess effects of the use of plant protection products based on chlorotoluron as active substance, various designs of laboratory tests with Lemna sp. and other species and also mesocosm studies including different macrophyte species are available. Since it is not possible to cover all possible exposure scenarios, TK-TD modelling was used as an additional approach to address the potential effects of short-term exposure as predicted for some FOCUS surface water scenarios. The Lemna TK-TD model developed by Schmitt et al. (2015) was used to simulate laboratory tests assuming exponential growth as observed in the experimental controls. Growth under field conditions was modelled as dependent on C/N ratio and maximum light conditions as well. The substance-specific TK-TD parameters were calibrated using the results of a growth inhibition test with 7 days of exposure followed by 7 days of recovery in fresh medium without test item. The so calibrated model was verified by comparing its predictions with results of three other tests with different exposure patterns, some of which were designed with this purpose in mind. Modelling conditions were close to or above 0.9 for all four tests and, thus, the model was considered suitable for simulating effects of different exposure pattern on the growth of Lemna. We simulated laboratory refined exposure tests with PEC profiles of the 7 days worst-case time window of the FOCUS step 3 scenarios as well as field populations using the full FOCUS profiles as inputs. For the exposure profiles characterized by short-term pulses, margins of safety were above 10 to reach a 50 % inhibition of the growth rate over 7 days, the endpoint used in Tier 1. For the simulated field tests, maximum deviation of biomass under control and exposure conditions was used as assessment endpoint. If up to 25 % deviation of biomass of an exposed population from a control population is considered a negligible effect, the Margins of Safety was above 20 all analysed scenarios. The experimental results show that for well-differentiated species, the model results especially for relation between effects observed in short-term exposure experiments to answer both questions. We will employ short-term experiments, lasting 48h with two short peaks of 4h duration, at 3 different term time scales, by concurrently reproducing the growth conditions. The exposure experiments considered here will, with a high probability, not lead to unacceptable effects on macrophytes. This project demonstrates the usefulness of modelling as an additional tool in risk assessment of plant protection products, particularly for extrapolation between scenarios which cannot all be tested experimentally.

**M0359**

TK/TD modelling as a tiered approach to reveal interspecies variability of toxicity in fish

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Species sensitivity distribution (SSD) analysis can be used in higher tier risk assessment to describe the variation in sensitivity of a group of species to a certain contaminant. Contrary to the standard procedure in which toxicity endpoints are derived by considering only effects at the end of a constant exposure experiment, this method has the potential to additionally make use of time-variable exposure and organism response over time. Here, changes in SSD (and the corresponding HC5) were investigated for a scenario with 10 species using the toxicokinetic/toxicodynamic (TK/TD) model for survival GUTS. The GUTS model was parameterized based on standard acute tests for each fish species and both stochastic death (GUTS-SD) and individual tolerance (GUTS-IT) assumptions were tested. Then, the 58-day LC50 for constant exposure and for two different pulse exposure scenarios (single and double pulses) were derived. The LC50 values were subsequently used as input for the SSD calculations. The SSDs were derived by fitting probability distributions to the LC50 data, and the corresponding HCs5 were determined. The analysis was performed separately for two compounds. Results with both toxics revealed that the sensitivity ranking for the fish species and consequently the HC5 values were not the same among the tested exposure scenarios. Predictions with either GUTS-SD or GUTS-IT models also had an impact on the SSDs and did not yield the same results for the same exposure profile. Additionally, longer exposure durations did not always result in lower HCs. These findings infer that SSD strongly depends on the exposure scenario, and reveal the interference of substance toxicokinetics and organism responses to toxicity in determining the sensitivity ranking of the species. Therefore, it is essential for a reliable environmental risk assessment not only to consider realistic exposure scenarios, but also the TK/TD processes related to the substance and the organism. With a set of standard data, the GUTS model can help to achieve this goal for untested exposure patterns.

**M0360**

RIFCON EasyGUTS: Ready-to-use and freely available software for TK/TD modelling of survival

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GUTS (General Unified Threshold model of Survival) is one of the most commonly used models for toxicokinetic and toxicodynamic evaluations of aquatic experiments in the context of the European registration of plant protection products at lower tiers in the ecotoxicological risk assessment. One user friendly implementation of this model is the Windows based program EasyGUTS. This implementation and its functionalities were recently tested and verified using published data. Results obtained with EasyGUTS are in good agreement with results obtained from various other publications and model implementations. However, one limitation of the program during this verification process was that it was only possible to select the log-normal distribution for the individual tolerance model rather than giving the possibility to also use other functions like a log-logistic distribution. This was the case since the GUTS R package to which EasyGUTS is linked, is restricted to only this possibility. Since a TK/TD draft guideline is expected earliest next year and no preference for a distribution is given in recent publications, in line with the EFSA ‘Scientific Opinion on Good Modeling Practice’. Moreover, EasyGUTS as a functional tool was tested in internal and external modelling workshops. Our experience is that the usability of the software and the robustness of the calibration algorithm was fitting well, so that even all users could reproduce results and decisions. Since EasyGUTS is finally verified and harmonised with the R GUTS package, it is ready to use under free license agreement and can be downloaded from the RIFCON homepage beginning of 2018. This poster presents the user interface of EasyGUTS and gives insight on the sensitivity of the model to initial parameter values and the influence of different distributions used for the individual tolerance model.

**M0361**

A new test design to inform TKTD models on species sensitivity

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Recently, several TK/TD population modelling approaches have been developed and are applied in different risk assessment areas. The European Food Safety Authority (EFSA) guidance on tiered risk assessment for plant protection products for aquatic organisms in edge-of-field surface water of the R GUTS modelling as an approach for the aquatic risk assessment for the evaluation of time variable exposure. For aquatic invertebrates two key questions exists for the ecological threshold option. 1) What is the species sensitivity distribution 2) What are the effects from short-term / peak exposure patterns on long-term survival and reproduction. Currently TK/TD models are parameterised on the standard Tier 1 or Tier 2 approach. Particularly in chronic studies, test organisms are continuously exposed over long time periods (week to months), which makes these experiments costly, time consuming and which limits the number of non-standard species to be investigated, as these species - in the absence of appropriate husbandry and test methods and due to complex biology - are particularly challenging to test reproducibly in chronic set-up’s. Here we will present an approach using the GUTS model (TK/TD model for survival) informed by specific published data. Results obtained with EasyGUTS are in good agreement with published data. We will work on short-term experiments, lasting 48h with two short peaks of 4h duration, at 3 different treatments levels of an insecticide, in combination with several observation time points for 5 aquatic insect species and 3 crustaceans. The outcome of these experiments will inform the GUTS model and will allow for a suitable calibration, after which it will then be possible to construct pattern-specific species sensitivity distributions to be used in acute effect assessments for time variable exposure patterns like FOCUS scenarios. Moreover, the approach may also provide further insights whether peak exposure experiments in an acute study design can be used to investigate sensitivity differences also on a longer-term time scale, by concurrently preventing the pitfalls and potential artefacts arising from not yet developed, adequate long-term husbandry- and test protocols for non-standard species.

**M0362**

Impact of temperature on species sensitivity distribution in aquatic invertebrates

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Aquatic effect assessment uses results from laboratory experiments at constant environmental conditions. However, for these tests organisms are kept under optimal temperatures which might differ across species. If done for multiple species, results from these toxicity tests are used to statistically derive community level endpoints, such as the HC5, from species sensitivity distributions (SSDs). Therefore, data from acute toxicity tests are ranked using cumulative distribution. Apparent toxicity often occurs, such as the LC50s, have been reported to depend on ambient temperatures as well as on exposure situations in aquatic invertebrates and fish. If comparing species sensitivity the results might be biased by the experimental conditions. It has been demonstrated that changes in physiological rates with different temperature regimes can be described by the Arrhenius function. Part of this study is to examine if the Arrhenius function is also able to predict TKTD model rates, such as GUTS, for different temperatures. We use GUTS to extrapolate toxic effects across temperatures and investigate the impact of temperature on a species sensitivity distribution (SSD) with aquatic invertebrates regarding Chlorpyrifos.

**MO363**

**Lemma toxicokinetic and toxicodynamic (TK/TD) modelling - Impact of the ecological scenario on the risk assessment**

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Recently, several TK/TD population modelling approaches have been developed and are applied in different risk assessment areas. The European Food Safety Authority (EFSA) Toxicokinetics and Toxicodynamics working group for aquatic organisms in edge-of-field surface waters, states TK/TD population modelling as an approach for the aquatic risk assessment. Although, the EFSA aquatic guidance states TK/TD population modelling as a method for the risk assessment, there is a lack of guidance and practical experiences for this new technique – especially to what extent the environmental scenario in which a TK/TD population model is applied influences the outcomes of the risk assessment. Unfortunately, it is not obvious which environmental scenario is a conservative one, e.g. a high or a low level of nutrient or temperature. In this contribution, we analysed the sensitivity of a *Lemma* model (Schmitt et al., 2015) to changes in environmental conditions in a risk assessment case study. For this case study we considered exposure to a toxicant and conducted several simulations with the *Lemma* model. While the exposure situation was kept equal in all simulations, the environmental conditions were changed. Results demonstrate that population dynamics are altered the most in cases where the exposure occurred in phases with strong growth of *Lemma*. This analysis can be the basis to set a conservative ecological scenario for environmental risk assessment for *Lemma* TK/TD modelling approaches.

**MO364**

**Defining ecological lake scenarios for population modelling as part of the Ecological Risk Assessment of chemicals**

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The ecological risk assessment of chemicals (ERA) aims to minimize adverse ecological effects on populations and ecosystems. This assessment strongly depends on the selection of the underlying ecological scenarios and the species sensitivity to anthropogenic stressors. This also applies to the populations of planktonic species and fish in standing waters (lentic systems), many of them being focal species in ERA. For use in population modelling, we suggest a classification of ecological scenarios of lentic systems based on the EU Water Framework Directive (WFD). As a result of the European intercalibration process, a list of general lake types has been defined which includes many of the aspects that are important for lake modelling. Besides abiotic characteristics, the German lake classification system for the national implementation of the WFD additionally makes use of biocenotic and trophic descriptors, and provides short characterizations of typical characteristics for relevant lake types. For the German lake types, data on e.g. phytoplankton biomass and nutrient concentrations are available from natural reference lakes which can serve for model validation. As case studies, we have chosen three lake types from this list of general lake types, which differ in relevant lake properties such as morphometry, trophic state, water depth, stratification regime during summer, and food web structure of the pelagic food web. We additionally considered common anthropogenic lakes and ponds (e.g. high industrialization and dense urbanization) as well as the establishment of safe ecological thresholds as predicted no-effect concentration (PNEC), based on procedures incorporated in the REACH regulation and Water Framework Directive and in related guidelines. These policies offer three methodologies for deriving PNEC: use of assessment factors (AF), species

**MO365**

**The use of population models in copper risk assessment: a case study with Acipenser transmontanus**

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Current metal risk assessment considers assessing single-species data on metal toxicity and constructing species sensitivity distribution (SSD) for the derivation of safe thresholds. Despite their usefulness, SSDs have been criticized over the last decades for being ecologically unrealistic, and for typically only accounting for individual-level endpoints. Population models as an alternative are becoming more popular in ecotoxicology as they translate a pollutant’s effects on individuals (e.g. survival) to the population level (e.g. growth rate). Additionally, ecological models are less expensive and time-consuming to develop and perform research with compared to population experiments. In this study, we aimed at adapting an existing white sturgeon (*Acipenser transmontanus*) population model to predict population level effects of copper toxicity. The white sturgeon is a fish species particularly sensitive to copper during early developmental life stages. An individual-based model (IBM) was implemented using the software platform NextLogo. Copper effects were integrated by adjusting the mortality rate for the sensitive life stage (age-0 individuals) for different scenarios (i.e. environmental configurations, exposure profiles, etc.) population-level effects were assessed as a function of the copper concentration. As expected, population equilibrium density decreased with increasing copper concentrations. Effect concentrations (ECx) values for population equilibrium density were situated in the same range (as traditional) lethal concentrations (LCx, values) at the individual level. Nonetheless, the magnitude of the population’s response to copper depends on several environmental factors such as habitat fragmentation and distribution of the pollution in the river system (random, heterogeneous, or homogeneous). Population ECx values were derived with the IBM by extrapolating observed (conventional LCx, values from literature. Here, the adapted population model for *A. transmontanus* contains some inherent assumptions which need further fine-tuning. By investigating the mortality profile (i.e. mortality over time) in depth, the mortality sub-model could be improved further, increasing predictability of the model. Additionally, investigating population density-dependent effects on the survival of age-0 individuals could increase accuracy as well. This study shows that population models could be used as more ecologically-relevant tools in metal risk assessment.

**MO366**

**Comparison of toxic effects on Daphnia magna between a metal, a pesticide, and a PAH, in a toxicokinetic-toxicodynamic framework**

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Modelling techniques are becoming more prominent in the risk assessment of chemicals. Mechanistic models, such as individual-based models (IBM) with a foundation in the dynamic energy budget (DEB) theory, are increasingly promoted as alternative tools in ecological risk assessment. In this context, lethal toxicokinetic-toxicodynamic (TKTD) models are often used to describe (sub-)lethal effects on the life cycle of the modelled organism. Inherently, the mode of action will differ between compounds (i.e. compounds will affect different physiological processes). The current study compares TKTD parameters of three different compounds, and examines their influence on the dynamic energy budget (DEB) model for *Daphnia magna*. The DEB model was made between three model substances: a heavy metal (Cu), a pesticide (endosulfan), and a poly-aromatic hydrocarbon (pyrene). The TKTD model was calibrated for each compound based on life cycle experiments with *Daphnia magna* effects of the three compounds. During life cycle experiments (21-days), growth, reproduction and survival were monitored at different concentrations for each of the compounds. Using all three endpoints, the modes of actions and the TKTD parameters were estimated for copper, endosulfan, and pyrene. Combining the TKTD model with DEB-IBM, effects on physiological processes can be translated to the organism level.

**MO367**

**Defining predicted no-effect concentrations for perfluoroalkyl acids in the Po river ecosystem through a novel methodology based on the AQUATOX ecosystem model**

A. Gregeli, A. Barausse, L. Grechi, L. Palmeri, University of Padua / Department of Industrial Engineering

Health and environmental risks posed by perfluoroalkyl acids (PFAs) have been of increasing concern through their widespread occurrence in the environment and human consumption. PFAs are non-biodegradable, and are suspected of having endocrine-disrupting effects. One of the most important ecosystems is the Po river basin, which is representative of the larger Mediterranean basin. Health and environmental risks posed by perfluoroalkyl acids (PFAs) have been of increasing concern through their widespread occurrence in the environment and human consumption. PFAs are non-biodegradable, and are suspected of having endocrine-disrupting effects. One of the most important ecosystems is the Po river basin, which is representative of the larger Mediterranean basin. The Po river is one of the most important ecosystems in Europe, which is why for simulating the nutrient and plankton dynamics in detail. Based on scenario analyses, simulations of typical plankton dynamics in lake systems will be presented and discussed.
sensitivity distribution (SSD), and results from model ecosystems and field studies whose task is to extrapolate single-species data to ecosystem-level responses. Although AF and SSD methods are described by strict guidelines making them commonly applied, they do not consider the effects of ecological interactions between species on the assessed risk level, which is potentially not-negligible since population dynamics in polluted environment are not only driven by direct toxicity of chemicals on single species. One cost-effective alternative for assessing the ecological risk of chemicals considering also indirect ecological effects is the use of mechanistic ecosystem models, simulating the multiple interactions between biotic and abiotic ecosystem compartments. However, there is lack of official guidance for models choice, development and use, resulting in scarce implementation of ecological models for regulatory purposes. Accordingly, two main goals of this work were to develop a methodology for deriving PNEC by use of the US-EPA AQUATOX ecosystem model, and to evaluate the risk posed by PFAAs (represented by two long-chained and two short-chained compounds) in the ecosystem of the Po, the greatest river in the Northern Italy. Through AQUATOX, water concentrations of PFAAs resulting in a non-negligible biomass loss for each modelled population of the ecosystem were assessed, thus connecting biomass density (a model output) to a "safe" concentration (PNEC). The resulting PNECs were compared to PNECs derived with conventionally used AF and SSD methods to assess the performance of the proposed novel methodology.

MO368
Incorporating spatially explicit metapopulation models as the endpoint of an Adverse Outcome Pathway-based Bayesian Network-Relative Risk Model
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Population viability analysis is useful tool for assessing the environmental risk of toxicants because it produces endpoints relevant to managers and can be manipulated to compare the potential outcomes of conservation actions. In general, many Environmental Risk Assessments (ERAs) lack utility and realism because they fail to incorporate the combined effects of lethal and multiple sub-lethal impacts, environmental stressors, and chemical mixtures into a relevant endpoint for managers. To improve the utility of regional scale risk assessment, we are developing a Bayesian Network-Relative Risk Model that incorporates the combined effects of toxicants and environmental stressors into an Adverse Outcome Pathway (AOP) framework linking environmental conditions to spatially explicit metapopulation models. As a primary case study for this new model, we are examining the impacts of organophosphate (OP) insecticides on ESA-listed chinook (Oncorhyncus tshawytscha) and coho (Oncorhyncus kisutch) salmon populations using site specific data from the Lower Skagit, Nooksack, Cedar, and Yakima River watersheds in Washington State. The AOP within the BN-BRM links concentrations of OPs to % Acetylcholinesterase (AChE) inhibition which is then linked to sublethal impacts that are incorporated into metapopulation models through age-specific reductions in survival and reproduction. The outcome of this effort will be an adaptable management tool that uses existing, disparate data to link realistic toxicant concentrations to probabilistic population outcomes. The preliminary results from this model development suggest that environmentally realistic concentrations of OPs may slow the growth of salmon populations, undermining the success of current restoration efforts.

MO369
Modeling and monitoring the effects on the central nervous system of a chronic exposure to low dose of pollutants: an innovative strategy with first results
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Chronic low dose exposure and possible cumulative effects of various pollutants could affect consumer health and may contribute to the development of neurodegenerative pathologies. Due to the highly complex and long exposure, a clear and direct evidence for causality is often difficult to be interpreted, but rarely proven. An additional drawback is the high diversity of in vitro models (cancer cell lines, stem cells, primary embryonic cells), bringing additional complexity in the deciphering of the observed effects of pollutants. To properly assess the risks and to reevaluate the maximal acceptable dose of specific pollutants in the food chain, there is a need for efficient modeling of pollutant effects on the central nervous system (CNS). To address this need, we are developing a new approach to evaluate the consequences on neuronal health of long time exposure to pollutants. We are actually re-evaluating the neurotoxic effects of chlordecone (CLD) as proof-of-concept of our strategy. Several concentrations of CLD were used to treat a variety of mouse primary neurons isolated from different postnatal CNS areas. We then assessed neuronal functions using specific markers for neuronal death, neurite development and synapse formation. In parallel, we produced cerebrospinal fluid (CSF) from pigs exposed to CLD via contaminated food. This CSF containing CLD and its by-products that are able to cross the blood brain barrier could then be used on the same cultures to compare its effect with that of the respective neuronal cultures. We were able to identify a direct neurotoxic effect (10 µM) on specific purified neuronal cultures together with more subtle damages at lower concentrations including neurite arborization defects (0.1 to 1µM depending on the respective neuronal cultures). Additional effects on pure glia cell cultures at higher concentrations (100 µM) suggest a reactive gliosis in the whole animal. These observations were confirmed by CSF treatment using CLD-contaminated CSF but not with CSF from control pigs. In addition, the dose with no observable effects is at least 10 times lower using primary postnatal neuronal cultures compared to embryonic cultures. Our experimental model is therefore much more sensitive and may reflect more precisely the consequences of chronic CLD exposure. Our strategy could help to re-evaluate the CNS effects of this remnant pollutant present in West Indies soils.

MO370
A new classification method for mechanisms of toxic action
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A knowledge of the mechanism of action (MechoA) of substances is a crucial first step in risk assessment approaches, especially when using in silico models to predict (ecotox)icity. Mechanisms of Action are similar to Molecular initiating Events which govern molecular interactions between xenobiotics and biological material. Using the accumulated knowledge of MechoAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechoAs. Consequently, a new method to predict MechoAs with high accuracy and with simple rules was developed (Bauer et al. 2018). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Enouch et al., 2008) and Russom (MOA classification by OASIS implemented in OECD QSAR Toolbox) (Russom et al., 1997) methods, and our decision tree showed the best statistics. This method is currently being implemented into a software, and it will be made freely available and we consider it as a useful support in risk assessment. This model will be constantly enhanced with the addition of new rules and minor corrections as needed.

Biocides and Veterinary Medicines: latest developments in regulatory risk assessment, research and monitoring (P)

MO371
Biocide leaching from building facades: Pseudo-persistence in soil due to reoccurring emissions
U. Bollmann, Aarhus University / Environmental Science; D. Fernández-Calviño, K.K. Brändt, University of Copenhagen / Department of Plant and Environmental Sciences; M.S. Storgaard, Aarhus University, Department of Environmental Science / Department of Environmental Science; H. Sanderson, K. Bester, Aarhus University / Environmental Science

Facade paints and render are commonly protected against biological deterioration using biocides. Mixtures of in-can as well as film preserving bactericides, algaecides and fungicides are added to the materials. Nevertheless, active ingredients leach from the treated facades, if contacted with wind-driven rain. Especially in suburban residential areas a large fraction drains directly to soil, e.g., flowerbeds, gravel strips or the lawns surrounding the houses. Consequently, the soil in areas with biocide-treated buildings is exposed to rain runoff water highly polluted with biocides. In the present study, the degradation rates of eleven biocides in soil were determined in laboratory microcosms. Degradation half-lives ranged from rapidly degrading (TC50 < 10 d) to compounds with higher persistence (TC50 > 120 d). For two selected biocides (terbutryn and octylisothiazolinone) a set of transformation products were quantified in the microcosms as well. This showed that the mass balance for terbutryn could be closed with nine analysed transformation products for the entire incubation period (120 d), revealing that relative persistent metabolites are formed. In contrary, the mass balance including transformation products for octylisothiazolinone was not closed, as many transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Aliivibrio fischeri than the
New Developments in Environmental Emission Scenarios of Biocides

K. Michaelis, German Environment Agency (UBA); M. Schwander, German Environment Agency Umweltbundesamt; M. Galler, M. Schweitzer, SCC GmbH

Preservatives for products during storage are also known as in-can preservatives and are regulated according to Regulation (EU) No 528/2012 (BPR). These preservatives are biocidal products which are used in many different end-products (e.g. detergents, paints, glues etc.) to prolong their service life. The environmental emission of these end-products is evaluated in the European Standardisation Document (ESD), whereas the existing ESD for in-can preservatives does not contain calculations for the variety of all end-products. Consequently, the German Environment Agency (UBA) initiated a research and development project for the further development of the evaluation method of in-can preservatives. The draft for the revised ESD has been prepared by SCC GmbH on behalf of the German UBA. Due to the variety of different applications of in-can preservatives, a differentiation in 6 sub-categories was defined. Additionally, for a complete environmental emission estimation different life cycle steps of the biocidal end-product have to be assessed. Consequently, the incorporation of the in-can preservative into the end-product (formulation) as well as the uses of the end-product (application and service life) within a subcategory have to be considered. To reduce the workload and to standardize the emission estimation it was decided to define emission scenarios which describe a realistic worst-case situation for the environment refer to application amount, emission days and release fractions. On the basis of expert knowldege, draft competent authority reports of in-can preservatives and a survey between stakeholders, industry and other EU member states worst-case scenarios were identified and discussed at EU level. Finally, the revised ESD suggest one or a few worst-case scenarios, calculation sheets for the estimation of the emission from other uses are provided as Appendices, so that the emission from other end-products (non-worst-case scenarios) can be calculated as well, by using this ESD.

MO375 Monitoring of Biocides in German Sewage Treatment Plant Effluents - First Results

C. Meier, German Environment Agency (UBA) / Biocides; K. Pohl, German Environment Agency (UBA) / Section Biocides; M. Alting, I. Noeh, German Environment Agency UBA / Biocides; A. Thoma, F. Sacher, DVGW Water Technology Center; M. Kaiser, S. Fuchs, Karlsruhe Institute of Technology KIT / IWG

Due to a widespread use, biocidal active substances and their transformation products are expected to be found in the environment. Projections show that there will be an increase of biocide entries in the environment, mainly in urban areas due to increased use of e.g. disinfectants and especially masonry preservatives. Biocidal substances enter the environment through numerous entry pathways. One main entry path is through sewage treatment plants (STP). Therefore, the German Environment Agency (UBA) initiated a project where the effluent of 29 public STPs from all over Germany will be investigated over a period of one year, starting in November 2017. Additionally, selected samples from influents as well as from sewage sludge emissions will be in the focus. Using a prioritisation concept for biocides a list, ranking substances that enter the environment through the STP-pathway was generated. The list was judged by experts and finally, for this project 23 biocidal active substances or transformation products were chosen for analysis. First results show that several substances can be detected at measurable concentrations in the effluents. This ongoing project will provide better knowledge about the fate and behaviour of biocides entering the environment through sewage treatment plants. It will give us a time dependent picture of the environmental pollution by biocides in Germany through urban STPs and will also show possible fields of action for regulatory purposes.
Both inhalation and oral route were especially considered in this research under the model in Korea. In this study, the exposure of CMIT/MIT is different level of exposure models to discuss the applicability of European exposure mixture were recalled in 2016 even though its tox contrast, CMIT/MIT was detected in toothpaste and the products containing the been used as humidifier disi

MO378 Are biocide emissions into the environment already at alarming levels? Recommendations of the German Environment Agency (UBA) for an approach to study the impact of biocides on the environment K. Pohl, German Environment Agency (UBA) / Section Biocides; C. Meier, German Environment Agency (UBA) / Biocides; M. Ahting, I. Noeh, German Environment Agency UBA / Biocides

More than 40,000 biocidal products were registered on the German market, including disinfectants, preservatives, pest control and antifouling products. All biocides act as intended on living organisms and the use of these biocides can result in adverse impacts on the behavior of biohazard substances containing their individual findings of only a few substances, particularly in surface water.

However, a comprehensive picture of the actual pollution of the environment with biocides – one that goes beyond such individual findings – is not available, since there is no biocide-oriented, systematic environmental monitoring in Germany to date. To tackle this problem, the German Environment Agency (UBA) has developed recommendations for an environmental monitoring programme on biocides based on the results of a research project and two international workshops. These recommendations contain a prioritization concept for biocidal substances as well as a proposal for a systematic monitoring programme. At first, we established a database containing information relevant for the environmental risk assessment according to the Guidance on Biocidal Products Regulation (BPR) for all biocidal substances currently available on the market. A multi-criteria prioritization approach was applied to prioritize substances based on their 1) emission relevance, 2) environmental effect data, and 3) environmental persistence. Thereby creating lists of high-prioritised biocidal substances and relevant transformation products that are of particular concern for the environment. Instead of monitoring individual effects with our approach at monitoring the entry pathway of relevant biocidal substances. Therefore, we developed different entry path scenarios (work packages), which represent the different use pattern and entry paths of particular biocidal products. Based on the obtained prioritised substances and the different entry paths a systematic monitoring strategy is suggested for a German wide inventory of biocides in the environment. This will provide on one hand better knowledge on the behavior of biohazard substances containing their impact on the environment. On the other hand, these monitoring data could help to support a more comprehensive risk assessment of biocides by providing a basis for risk mitigation measures or for the exclusion and substitution of environmentally hazardous active substances.

MO379 Hazard evaluation of biocides and its metabolites for the aquatic compartment D. Hernandez-Moreno, INIA / Environment; M. Blazquez, INKOA SISTEMAS / RTD; O. Andreu-Sánchez, Xenobiotics; A. Bermejo-Nogales, M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment

The LIFE-COMBASE project main target is to promote the sustainable use of biocidal active substances by developing prediction models. As a first step, a database compiling aquatic toxicity data to the aquatic compartment for biocides and derived metabolites has been implemented. The aim of the present study is to make a critical review of this information in order to have a wide view about their potential risk for the aquatic compartment. All the biocides approved and under review were compiled (277 active substances; Regulation (EU) 528/2012). A selection of 192 biocides with possibilities to be modeled and a search using several official and scientific databases, looking for any possible metabolite derived from their release in the aquatic compartment were done. Data was collected in an excel file, including identification of the biocide or metabolite (EC NR, CAS NR, SMILES), classification data (main group, product type, regulatory status), LogP, hazard assessment and metabolic profile and acute and chronic toxicity data for fish, invertebrates, algae and WWTP microorganisms. The EU Regulation (EC) No 1272/2008 on classification and labeling was considered to group these compounds in four toxicity categories taking into account the values of NOEC or LC50: a) 1 (≤ 1 mg/L), 2 (>1 to ≤ 10 mg/L), 3 (>10 to ≤ 100 mg/L) and 4 (>100 mg/L). Most of the found data was related to toxicity in fish, followed by invertebrates and algae, macromolecules being the least studied. There was not reported data for around a fifth of the 185 metabolites found, probably due to, in some cases, their commercial unavailability. Another identified problem was that some data were developed with formulated products or with active substances for which purity was not reported. Data already analyzed for the acute toxicity indicated that, 62% of the biocides were located in category 1 for invertebrates, 54 % for fish and 52% for algae. Only 24% of the biocides belong to this category for the microorganisms group. Metabolites are mainly less toxic than the parent biocides, however many of them present the same toxicity and very few (≤ 5%) are more toxic. The ongoing work indicates that biocides and a considerable percentage of their metabolites present a high toxicity for the aquatic species. It also identifies data gaps related to the ecotoxicological potential for metabolites. Acknowledgements: LIFE-COMBASE project (LIFE15 ENV/ES/000416).

MO380 Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhelk (Nucella lapillus) from Norway, 1991-2015 M. Schifer, NIVA / Marine Research; CH. Brese, NIVA / Oceanography; M. Schøyen (Nucel / Institute for Water Research / NIVA) / Centre for Coastal and Marine Research; L.A. Tveiten, Norwegian Institute for Water Research NIVA / Marine Biology; B.A. Bøyleich, S. Øksnevad, Norwegian Institute for Water Research NIVA / marine pollution; D. Hjerrmann, Norwegian Institute for Water Research NIVA / Oceanography; J. Beyer, N.W. Green, NIVA Norwegian Institute for Water Research / marine pollution Imposex is TBT-induced modification of male sex-characters in female dogwhelk (Nucella lapillus). This biological effect is quantified by the Vas Deferens Sequence Index (VDSI). Levels of imposex and TBT in N. lapillus have been monitored annually in Norway since 1991. Populations around the North Sea were critical reduced in the 1990s, due to increased use of TBT-based antifouling paints. Before the global TBT-ban in 2008, increased TBT-levels coincided with increased imposex prevalence at many monitoring sites located close to high maritime activity. After 2008, decreasing TBT-trends at former impacted sites, lead to population recovery of N. lapillus. The observations in N. lapillus further corroborated by monitoring data showing decreased TBT levels in blue mussel (Mytilus spp.). This monitoring data confirm the rationale of implementing strict international regulations on industrial chemicals when this can be linked to ecological perturbations in coastal ecosystems. The TBT/imposex monitoring was conducted at eight coastal stations representing the Norwegian coast from the Oslofjord to the Varangerfjord, following the guidelines given by OSPAR and ICES. Subsequently, 50 specimens from each station was analysed individually for imposex/VDSI and pooled (only females) for TBT and other organotin like (≤ 1 mg/L). The observations in N. lapillus at eight stations in 2015. At most stations, VDSI was 0 or below 0 and below the OSPARs Background Assessment Criteria (BAC=0.3). The highest level (VDSI=0.828) was found at the shipping channel Karmсудnet, which were above BAC but below the OSPARs Ecotoxicological Assessment Criteria (EAC=2). There were significant downward long-term (whole period 1991-2015) and short-term (recent 10 years 2006-2015) trends for both imposex/VDSI and TBT based on time trend analysis. These results show that the Norwegian legislation banning use of TBT on boats less than 25 m in 1990, on larger ships internationally from 2003, and the total ban in 2008 have been effective
in reducing imposex in *N. lapillus* and have re-established some of the populations. Low levels or significant downward long-term and short-term trends for TBT in common periwinkle (*Littorina littorea*) and blue mussel (*Mytilus spp.*) substantiate this.

**MO381**

**Risk assessment issues for algaecides under BPR**

C. Durou, M. Dariette, J. Rivera, CEHTRA SAS

A prospective and comprehensive environmental risk assessment (ERA) must be performed on the active substance for the market authorisation of biocidal products. The technical guidelines are made publicly available by ECHA. The data required for the ERA include the determination of a set of properties (physical-chemical, fate properties, short- and long-term ecotoxicity), an effective in-use dose or concentration, frequency of application of the biocidal product etc. In coming years, a prospective risk assessment has to be prepared in order to address the risk associated with the use of biocidal containing these active substances and also any substance of concern. The initial approach for a prospective environmental risk assessment will proceed with a Tier 1 calculation, which assumes 100% of the applied chemical will be released and ignores the formation of degradation products neither biodegradation of the active substance, neither consumption of active substance due to its biocidal activity. These initial assumptions may lead to an overestimation of the environmental exposure and risks to the active substance. The initial environmental risk assessment can be refined with supporting data e.g. on the degradation and/or dissipation of the active substance and also by consideration of risk evaluation realistic worst case scenarios for assessing the leading behavior. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several active substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algaecide applied in swimming pools. The poster will be focused on follow key issues: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for characterising the risks posed by the active substance to discuss possible options to refine the exposure of including new studies and risk management measures.

**MO382**

**Could a spatially distributed modelling approach enhance post approval considerations for veterinary medicines?**

C. McMillan, G. Hughes, J. Carnall, Cambridge Environmental Assessments

Tiered chemical risk assessment framework adopted in Europe for assessing the surface and groundwater risk from veterinary medicines used to treat livestock follows a tiered approach. The initial exposure assessment is a simplistic approach, with the FOCUS suite of models (FOrum for Co-ordination of pesticide fate models and their Use) often subsequently required for higher tier surface and groundwater refinement. Standard FOCUS scenarios defined within the guidance are intended to represent realistic worst cases to thoroughly assess the leading behaviour. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several active substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algaecide applied in swimming pools. The poster will be focused on follow key issues: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for characterising the risks posed by the active substance to discuss possible options to refine the exposure of including new studies and risk management measures.

**MO383**

**Are currently-adopted European guidelines on veterinary medicine product and feed additive risk assessment sufficiently cautionary?**

A. Di Guardo, Universita degli Studi di Milano-Bicocca / Department of Earth and Environmental Sciences; B. Kolar, National Laboratory of Health, Environment and Food; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences

Veterinary medicine products (VMPs) are used in livestock production to preserve animal health or to promote growth in certain categories of animal; feed additives (FAs) are products aimed at improving the quality of feed and the quality of food from animal origin, or to improve the animals’ performance and health. These substances may not be put on the market unless authorisation has been given following a scientific evaluation demonstrating that they have no harmful effects, on human and animal health and on the environment. In particular, according to European Framework Directive 2001/82/EC, the environmental risk assessment (ERA) procedures for VMPs are based on technical guidance documents which propose a tiered approach to calculate PECsoil and PECgw of VMPs from livestock manure spread on the field. On the same way, the ERA procedure for feed additives is reported in a technical guidance document from EFSA which describe a two-tiered approach to calculate PECsoil and PECfw from spread manure. Calculation of PECsoil proposed by the two ERAs in the first tier is directly related to the “annual nitrogen (N) emission standard” which is the amount of nitrogen per Hectare spread on or into the field. Both ERAs propose a default value of 170 kg N/ha which is the maximum allowed annual amount of nitrogen originating from animal manure on a farm within nitrate vulnerable zones (NVZ). On the other side, in Europe, NVZs are measured, and in total 23 substances actually existed in several zones higher thresholds of N emission standard are allowed. Both ERAs procedures could therefore underestimate the PECsoil with a potential environmental toxicity for non-target terrestrial organisms. This study is aimed to evaluate if PECsoil, calculated using standard models currently used in the authorization procedures of VMPs and FAs, are sufficiently adequate to protect soil and water quality. To this becomes available for other purposes, including prioritization. We also see that current monitoring schemes is not specifically aimed at veterinary medicines, and due to the fact that emissions, temporal and spatial trends, emission routes and concentrations at relevant locations are little available, no clear overview of risks is yet existing. We further noted that the origin of a detected compound cannot always be properly traced back to a specific animal use only. We noted that the compounds are also used in human medicines or as pesticides. Admission to the market, based on active substances, is therefore sometimes regulated in different rulemaking and also, usage data is scattered. This makes priority setting difficult when performed in a segregated view on the universe of chemicals.

**MO384**

**Quick scan to monitoring data of veterinary pharmaceuticals in the Netherlands**

S. Kools, T. ter Laak, KWR Watercycle Research Institute

On the Dutch market, approx. 260 active substances are used in different veterinary medicines. In a quick scan, we investigated the potential contribution of veterinary medicines to environmental exposures of N. lapillus - an intertidal and mobile gastropod species that is often used as a test organism when comparing to those obtained using more realistic exposure assessments will be evaluated.

**MO385**

**Comparing methods for estimating environmental emissions**


The environmental risk assessments consist of information on exposure and hazards of chemicals to environmental compartments. Environmental emissions from biocidal products are estimated according to Emission Scenario Documents (e.g. OECD). In some ESDs, the emission is calculated based on the use/consumption of the product as specified on the label (e.g. PT18), with a number of default assumptions applied. However, other ESDs include the facility to take account of tonnage information as well as average consumption values in product specific calculation models (e.g. PT2). Both approaches have strengths and weaknesses. However, the importance of establishing realistic and reliable methods of estimating environmental emissions cannot be understated, especially in light of the intention to develop guidance on aggregate assessment. Accordingly, this poster will illustrate on two approaches for estimating emissions: regional tonnage (top down) or consumption (bottom up). Opportunities and limitations of the applicability of the data and their implications for use in EU environmental exposure assessments will be evaluated.
Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information (P)

MO387 Recommendation on Steam Cracker allocation for the sake of comparability of petrochemicals products datasets used in LCA studies

G. Castelan, PlasticsEurope / LCA; P. Saling, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different mixtures of chemicals. Propylene, ethylene, butene, and butadiene are some of the byproducts. However, they have a large number of other products. These products are basic building blocks of many chemicals and polymers used in nearly all products and sectors. Thus LCA data of steam cracker products directly influence a huge amount of further downstream products. It is therefore important that LCA data for steam cracker products are modelled consistently, ensuring a reduction of uncertainty and a better interpretation by LCA experts, particularly in perspective of comparability, in LCA studies of these downstream products. Basing on ISO 14044 and on the abundant existing literature on this topic the Life Cycle Thinking and Sustainability working group of PlasticsEurope, composed of experts from its member companies, plus some experts of the Chemical Sector of the World Business Council for Sustainable Development, and some LCA consultants have issued a recommendation built through a consensus 5 years long process. The presentation will elaborate on the discussions and on the recommendation finally issued, considsered as the best compromise between comparability and specific representativeness. For multi-output processes, such as a steam cracker, ISO 14040 and 14044 standards define a hierarchy of several options. Due to the nature of steam cracker processes allocation is considered as the preferred option. The concept of defining a main “products” fixed list in combination with a mass-based allocation for steam crackers has led to a consistent LCA approach, independent from market prices, technological changes or market driven adaptations of steam cracker outputs. It gives practitioners a clear guidance for the allocation process. This results in less differing environmental data for steam cracker products and will lead to a higher comparability. The results are much more stable, although the same product will have slightly different LCI results depending on different amounts of products derived from the steam cracker. Such a collaborarative work towards streamlining should be engaged for all chemicals, and should be applied within all database both to background and foreground parts, like for example in the European EF compliant database.

MO388 Actual versus default uncertainty in ecovinent database

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Variability of national life cycle inventory flows is a relevant uncertainty source and should be properly informed in public databases. Within the scope of the Sustainable Recycling Industries project, life cycle inventories for Brazilian construction products were developed and submitted to ecovinent following its guidelines, including the preferred use of the lognormal distribution for uncertainty modelling, which requires converting sample average and variation into the geometric mean and the unbiased variance of the underlying normal distribution. However, dataset reviewers inform that most data providers do not perform these conversions and simply use the sample average for flow amounts, frequently associated to default basic uncertainty factors suggested by ecovinent. This work discusses the implications of three different uncertainty modelling approaches: 1) using both converted mean and variance, 2) using the sample average with the converted variance, 3) using the sample average and default basic uncertainty variance (probably the most common approach). Primary data collected in 25 concrete block factories were used in the analyses. Influence on life cycle impact assessment results was assessed using Monte Carlo simulation with 10,000 iterations, CML 1-A method and ecovinent v.3.2 “Rest of the World” datasets for upstream processes. Results show that the sample weighted average and the geometric mean differed significantly. Therefore, using the sample weighted average as a proxy for the lognormal geometric mean may overestimate impacts, in our case by approximately 10%, considering only the effects of the concrete block production process flows. Since existing datasets may have followed this approach, this may lead to increased uncertainty and misinterpretation of results. Hence, basic uncertainty values are significant lower than measured variations across manufacturing sites, which is inconsistent with a conservative estimation approach. Thus, uncertainty information provided by ecovinent might contain inconsistencies and lead to errors in uncertainty assessment, such as impact overestimation. Uncertainty modelling can be improved in the database by allowing the input of different amount parameters, permissive automatic conversions in the submission software or simplifying the provision of uncertainty data using simpler probability distributions.

MO389 Life cycle assessment of battery systems with harmonized life cycle inventories considering different storage applications

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The penetration of renewable electricity has greatly increased in the past decade. Battery is a key storage technology to balance supply and demand and to facilitate the world’s transition towards a sustainable energy system. However, having a comprehensive overview of batteries’ life cycle environmental performance still remains a challenge, because battery technologies are of various kinds and the applications of batteries vary. These applications are different from each other in terms of required power and energy size as well as number of cycles. Due to these different requirements by applications, the same battery technology needs to be operated differently and sized accordingly. Numerous studies in the past investigated the life cycle environmental performance of batteries; however, most of them are focused on the application of batteries in electric vehicles, considering a limited number of lithium-ion battery technologies, while the stationary applications of batteries were less explored in limited studies. In addition, these studies are mostly conducted based on diversified sources of life cycle inventory data, without harmonizing the assumptions that are necessarily different. Peters et al. have recently applied in real scale, the application of nanomaterials as adsorbsents, but they are compared without considering the applications. Another study by Baumann et al. considers the applications of battery in the assessment, without addressing the country of application, which results in partial understanding of contributions in the life cycle emissions. This study therefore addresses these challenges, by considering six battery technologies for five storage applications in three representative applications of Europe. On the basis of previous studies, the harmonization of inventory data is carried out to a greater extent. We also extend the scope of the system, which is often limited to battery pack, to include the complete balance of systems, which ensures the operation required by the applications. 

MO390 LCA of nano-adsorbents - Interpretation of laboratory results

A. Kazemi, Tarbiat Modares University / Department of Environmental Science, Faculty of Natural Resources; S.I. Olsen, Technical University of Denmark / DTU Management Engineering Division for Quantitative Sustainability Assessment; N. Bahrami, Tarbiat Modares University / Department of Environmental Science, Faculty of Natural Resources; A. Heydari, Tarbiat Modares Nano-adsorbents as an emerging product and a special application of nanomaterials can increasingly play an important role in the control and removal of environmental pollutants. An example of this is the use of nano-iron to remediate contaminated groundwater. However, even though particularly this example has been recently applied in real scale, the application of nanomaterials as adsorbents is still an emerging technology at the early stages of development. Hence, this study enables an environmental assessment of nano-adsorbents as an emerging product/technology based on the results from the laboratory. Two nano-adsorbents with graphene-based (MGO-NH-SH) and Fe₃O₄-based (FeO₄@SiO₂-NH-SH) composites, which function with a similar thiol group for Hg(II) removal are compared at different stages of the production. Removal of mercury is important due to its historic cases of fatal contamination and its continued use. Although mercury must be removed from the contaminated sites it is still very relevant to make an LCA in order to ensure a balance between the impacts of producing the nanoadsorbent versus the avoided impact of the mercury that is being removed. The environmental impacts of synthesised adsorbents including energy use, climate change, water use, human toxicity, and ecotoxicity are investigated by a stepwise procedure during their synthesis processes, regarding their potential to remove mercury from polluted water (functional unit is removal of 1 kg of Hg(II)). Accordingly, characterization results showed that although the process of the functionalization of nanoadsorbents leads to the increase of the adsorption capacity of the final products, it is also accompanied with a significant enhancement of negative environmental impacts. A “what-if” perspective was applied to assess the uncertainties of using lab-scale data for parameters including amounts of acid (HCl + H₂SO₄), ammonia, ethanolic, methanol, DCC (N,N'-dicyclohexylcarbodiimide), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of the test comparing the impacts between MGO-NH-SH and FeO₄@SiO₂-NH-SH estimated respectively 37%, 34%, 40%, 31%, and 26% more climate change; previous studies of mercury use, human toxicity, and ecotoxicity, respectively for the latter. Sensitivity analysis were employed to determine the uncertainties for scale-up production and it is shown that especially potential reductions of electricity use, ethanolic and DCC can reduce the impacts significantly.

MO391 Quantifying the influence of consumer behaviour on water, energy and greenhouse gas footprints of showering

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Life Cycle Assessment (LCA) has been used as a tool for environmental footprinting of a wide range of household cleaning activities. Even though differences in the way household activities are performed by consumers may alter the results of LCA, the variability in consumer behaviour is generally ignored in LCAs, which use the average behaviour as a basis for quantifying the environmental impacts. The goal of our study was to demonstrate how the data on consumers’ reasoned choices, consumers’ habits, climatic parameters, manufacturing of products and infrastructure of countries can be combined to quantify the variability in the energy use, greenhouse gas emissions and water footprints related to the life cycle of showering. The results of showering were modelled in 4 countries namely Australia, Switzerland, the United Kingdom and the United States using various data sources to quantify the associated variability. Results showed that both inter-country behavioural, climatic and infrastructural differences as well as intra-country variation in consumer behaviour are crucial for determining the variability in the life cycle environmental impacts. Inter-country variability - the ratio between the highest median footprint and the lowest median footprint over the four countries- in the 4 main output variables of the model i.e. energy use, GHG emissions, water withdrawal, water consumption and water scarcity was a factor of 1.5, 2.2, 1.4 and 5.8 respectively. Intra-country variability - the ratio between the 95th percentile and the 5th percentile of the distribution- was typically higher than inter-country variability and ranged between factors of 5 and a factor of 20 depending on the process and indicator considered. Sensitivity analysis showed that consumers’ reasoned choices - particularly heater type and shower flow rate- and their habitual behaviours - particularly shower duration-, are the dominant sources of variabilities. Reductions in the water and energy related impacts of showering through changing of reasoned choices are achievable by one-off decisions such as buying an energy efficient water heater. However, reducing the impacts through changing of consumers’ habits could be challenging and needs more systematic approaches as consumers tend to keep their old habits.

M394

Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments

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Nanomaterials (NM) will enter the environment via diverse pathways. Sewage sludge for example is repeatedly applied as fertilizer on farmland due to its high nutrient content. This may lead to an increasing and significant impact of Ag and CeO2 nanomaterials on the environment as a reactor determining fate and toxicity of other contaminants. In our research project, we wanted to determine, if different types of sulfidized AgNMs evoke a hazard assessment based on data from laboratory tests is acceptable. This was achieved by evaluating the ecotoxicological results of the laboratory experiment over 180 days reflect the substrate and environmental conditions for the specific life cycle assessment studies for WOSP cultivation. Thus, field experiments were conducted to increase the data basis and subsequently derive WOSP-specific emission factors. Furthermore, the project strives to develop robust but also generalisables statements about nitrous oxide emissions and ammonia volatilisation due to returning digestate from biogas plants to the field using state-of-the-art application methods. The results of the research project lead to an improved understanding of trade-offs in the environmental assessment of WOSP production including additional aspects such as fertilizer use efficiency.

The environment as a reactor determining fate and toxicity of nanomaterials (P)

M395

Long term effects of three different silver sulfide nanomaterials, silver nitrate and bulk silver sulfide on soil microorganisms and plants


Silver nanomaterials (AgNMs) are subjected to various transformations along their way into the sewage treatment plant (STP). Hereby the AgNMs are mainly transformed to silver sulfides (Ag2S) (Kaegi et al, 2011). Sparingly soluble Ag2S is considered as none toxic to soil organisms. In the STP the AgNMs adsorb to sewage sludge (Schlicht et al, 2013) and the arising biosolids will be applied in large quantities on agricultural land within the European Union. The main goal of the present study was to determine, if different types of sulfidized AgNMs evoke a...
difference in the toxicity of the AgNMs. A realistic exposure scenario was chosen. The five test materials NM-300K, previously sulfidized NM-300K, a nanoparticulate AgS, and bulk AgS were added with an influent concentration of 1 mg/L and AgNO₃ with an influent concentration of 0.5 mg/L into the denitrification of a simulated STPs continuously for 10 days. The sewage sludge of each treatment was dewatered and the biosolids were mixed with soil. After 0, 60, 90, 120, 150, and 180 days, the metal content in the digestive gland and rest of the body was measured. In parallel, we also performed an experiment where we exposed the same NPs in simulated in vitro invertebrate digestive juice and assessed the dissolution rate using (sp-) ICP MS. A preliminary data show that the dissolution rate of the NPs is mostly lower in the digestive glands, but NPs were also detected when the NPs were exposed only to the solution. This points to the formation of secondary NPs inside the organism. In vitro digestive juice model does not entirely represent the expected dissolution rate of NPs that was concluded from in vivo exposure. The usefulness of terrestrial isospos as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

MO398 Energy reserves and respiration rate in the earthworm Eisenia andrei after exposure to zinc in nanoparticle or ionic forms Z.M. Swiatk, Institute of Environmental Sciences, Jagiellonian University / Institute of Environmental Science; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation The energy budget is an indicator of the organisms' overall condition and the changes in the energy reserves and/or energy consumption rate have been used as biomarkers of toxic stress. To understand better the effect of different forms and concentrations of Zn and possible costs connected with the effective Zn regulation by the earthworm Eisenia andrei, we designed a TKTD experiment in which individuals were sampled over time for the available energy reserves (total lipid, sugar and protein contents), energy consumption (measured at both the cellular level and as the whole animal respiration rate) and internal Zn concentrations of the earthworms were exposed to ZnCl₂ or zinc nanoparticles (ZnO-NPs) in Lufa 2.2 soil for 21 days (uptake phase), followed by 14 day elimination phase in clean soil (recovery phase). Each species was tested for both ZnCl₂ (250 and 500 μg Zn g⁻¹ dry soil) and ZnO-NPs (500 and 1000 μg Zn g⁻¹ dry soil), corresponding to EC₅₀ and EC₅₀, for reproduction, plus control without added Zn. The results suggest that the earthworms are able to regulate internal Zn concentrations efficiently, regardless of its form and concentration, and can handle a serious impact on their energy reserves. Sugar content was the only energy reserve component which was significantly lower in 1000 ZnO-NPs than control (p=0.03) in the uptake phase. The total available energy reserves (Ea) and protein contents did not differ significantly between treatments but significant effect of day of exposure was found (p<0.0003). Neither treatment nor the exposure day affected the lipid content in the phase. In the elimination phase, no treatment or time of exposure influenced the O₂ consumption. The whole-organism respiration rate (measured as oxygen consumption) was not affected by Zn treatments in any of the two toxicokinetic phases. The results for the whole organism respiration rate will be additionally compared with those for the respiration rate measured at the cellular level as an electron transport activity, which is probably more prone to rapid temporal changes in conditions - as is the case for most biochemical biomarkers. The relationship between absorption and metabolism (i.e. respiration rates measured at different levels) or energy budget (i.e. all energy reserve components) and internal Zn concentrations will be discussed. This study was supported by the National Science Centre, Poland (2015/17/N/NZ8/01576).

MO399 Evaluating the Cellular & Humoral Immune Responses of the Terrestrial Isopod, Porcellio scaber, to Gold Nanoparticles C.A. Myall, University of Ljubljana, Biotechnical Fac. / Biotechnical Faculty; D. Drobre, University of Ljubljana / Department of Biology Gold nanoparticles are popular due to their stability, the ease with which they can be synthesised and the myriad of potential uses they could have, which includes drug delivery systems, cancer therapy and biosensors. It is inevitable that these nanoparticles (NPs) will find their way into the environment and therefore the possible effects they could have need to be evaluated. In particular, it is anticipated that organisms may recognise NPs as “foreign” and respond by modulating their immune system. To date, only a few studies have dealt with this issue. The aim of this study was to investigate the immunological response of the terrestrial isopod, Porcellio scaber, to gold NPs. These organisms are well-studied and have previously been used as models for environmental toxicity. As the immune system is an early responder to foreign matter, studying it in conjunction with traditionally used parameters of toxicology can give more information into the possible effects these particles may have. This current study used two types of gold NPs; one with an oxide coating and another with a PVP coating, both of which were approximately 26nm in diameter. The ingestion route, animals were fed gold NPs for 14 days. During this time the feeding, defecation and survival rates of the animals was recorded. After 14 days, hemolymph was removed and the number, viability and proportion of hemocytes were counted. Along with the cellular tests, the humoral side of the immune system was investigated by measuring the activity of the enzyme phenoloxidase, which is associated with melanisation and wound healing, in the hemolymph. The levels of immune markers, glutathione S-transferase and soluble acetylcysteinesterase, were also assayed. As the gut is thought to impede the NPs’ ability to journey into the Avena sativa (2017) 15:1000 K, a model does not entirely represent the expected dissolution rate of the NPs, and the availability of the Ag from the Ag₂S NPs did show a different trend with soil properties than those associated with melanisation and wound healing, in the hemolymph. The levels of immune markers, glutathione S-transferase and soluble acetylcysteinesterase, were also assayed. As the gut is thought to impede the NPs’ ability to journey into the digestive gland and rest of the body was measured. In parallel, we also performed an experiment where we exposed the same NPs in simulated in vitro invertebrate digestive juice and assessed the dissolution rate using (sp-) ICP MS. A preliminary data show that the dissolution rate of the NPs is mostly lower in the digestive glands, but NPs were also detected when the NPs were exposed only to the solution. This points to the formation of secondary NPs inside the organism. In vitro digestive juice model does not entirely represent the expected dissolution rate of NPs that was concluded from in vivo exposure. The usefulness of terrestrial isospos as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).
hemocoe, isopods were injected with gold NPs and then left for 48 hours to recover from the injection; in previous experiments 48 hours was shown to be enough time for hemocyte numbers to return to pre-injection levels. The total number of cells, viability and the proportion of hemocyte types were counted. These counts were then compared to the animals which had been fed NPs and to others that had been injected with a non-lethal dose of LPS. Preliminary data shows that the isopods cellular immune response is altered upon direct injection of NPs, but no such effect was found after their ingestion. The study is still ongoing.

**MO402** Determining the comparative ecotoxicity of Cd/Te quantum dots with three different functional groups in three species of soil dwelling organisms

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Soil is a natural resource that is important for a number of ecological reasons relating to ecosystems and bio-geochemical processes. These processes include plant production, nutrient cycling of organic matter, storage of water and carbon, and richness of pathogens in agricultural crops. Pore water is the interstitial water found between sediment and soil. Soil acts as a biological habitat and gene reserve for a variety of species which are involved in all the soil ecosystem health. Therefore contaminants released into soil can affect the organisms which dwell in them directly affecting soil richness. As nanoparticles are being released into the environment they are able to form complex structures with organic material and soil particles. In order to address the fate and behaviour of Cd/Te QDs three different functional groups (COOH, PEG, NH2) were used for soil ecotoxicity studies. The earthworm Eisenia andreii, pot worm Enchytraeus albidus and soil nematode Caenorhabditis elegans were used for following OECD and ISO protocols to determine comparative ecotoxicity. The nanomaterial distribution is soil was determined by using a flow through system combined with microwave digestion and ICP-MS where nanomaterials were pored onto soil as well as homogenously mixed and eluted using ultrapure water. It was found that a predominant amount of metals were found within the eluted interstitial water and that NH2 functional groups had a higher binding affinity to the soil. There was no mortality seen for both earthworms and pot worms exposed up to 500 mg/L over 21 and 28 days respectively. Significant stimulation in reproduction was seen at 5 mg/L for NH2 and 5 and 30 mg/L in the COOH for earthworms. Pot worms showed an insignificant bimodal response but a significant decrease in reproduction was seen at 5 mg/L in the NH2 group only. The nematodes showed a significant decrease in reproduction and feeding number. In conclusion – all functional groups. A dose dependent nanomaterial uptake was seen within the tissue of both the pot worms and nematodes but was only observed in the PEG group of the earthworm group. As nanomaterials are released in to the soil environment they exhibit a high mobility within pore water, this mobility is dependent on the functional groups of the nanomaterials release. Soil nematodes show the highest ecotoxicological response compared to earthworms and pot worms and should be used as an indicator species for nanomaterial release.

**MO403** Assessment of the differential effects of transformation on the toxicity of nanomaterials with different size and coating proprieties to soil bacteria and the nematode Caenorhabditis elegans

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Much of the work conducted to-date in nanotoxicology has focussed on understanding the toxicity of as-produced nanomaterials. However, environmental fate studies have shown that nanomaterials are frequently transformed in waste streams and natural systems, and that such transformation can modify toxicity. The aim of this study was to understand changes in absolute and relative toxicity of nanomaterials with different starting characteristics; In particular how environmental transformation affects the toxicity of nanoparticles in soil. To this aim the most common nanoparticle transformations were assessed and the environmental conditions lead to a convergence of nanomaterial characteristics and observed toxicities as compared to those of pristine forms. In order to establish the toxic effect of these materials three bacterial species (Arthrobacter globiformis, Janthobacterium lividum and Pseudomonas putida) were exposed to a range of concentration of nanoparticles with different size and surface properties and their growth inhibition determined. The reproductive toxicity of the selected nanomaterials on the nematode Caenorhabditis elegans was also assessed. Investigated were 4 types of silver (25 and 50 nm, uncoated and PVP), 5 types of polystyrene (50 nm unfunctionalised, amine (+ charge), carboxyl coated (- charge) and 100nm, 300nm unfunctionalised), 4 types of TiO2 nanoparticles (uncoated, PVP, F127, Pleuronic coatings, under dark and light conditions). Initial tests identified effects of particle properties for each core material. Size was found to have the greatest impact on Ag nanoparticle toxicity, whereas surface charge altered polystyrene toxicity the most. In TiO2 nanoparticle exposures uncoated and F127-coated nanoparticles showed the greatest differences in toxicity under dark and light conditions. Thus differences in the toxic effects of the pristine materials were established, although their ranking was not conserved between the species. Studies with chemically transformed or environmentally aged nanomaterials are currently under way to assess whether these differences persist after the silver nanoparticles are sulfidised and the polystyrene and TiO2 nanoparticles are aged in sewage treatment plant effluent.
significant induction of CAT at day 1, followed by an increase in its transcription levels after 3 and 14 d of exposure. Similarly, exposure to AgNO3 induced the transcription of CAT at day 1 but at day 14 a downregulation was observed. The CAT activity increased at both treatment and exposure times (1 and 3 d). After 14 d of exposure, CAT activity was inhibited at the highest concentration tested. The highest increase of MTS at protein level was observed after 3 d of exposure. Our results indicate that short-term exposures to Ag NPs induced early molecular stress responses (MT induction and oxidative stress) in coelomocytes that precede other responses at higher levels of biological organization. The responses in translational level in E. fetida tissues were according. The study indicates the importance of using integrative biomarkers for the evaluation of the potential risk of Ag- NPs in soils.

MO404 Effects of Cerium Nanoparticles with deferent surface-charge in coelomocytes of Eisenia fetida
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With the rapid development of nanotechnology and its broad applications, a wide variety of engineered nanoparticles are used in commodities, pharmaceuticals, cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO2-NPs) are used in the cosmetics industry, as well as in chemical-planarization agents in production of silicon wafers. This study investigated the toxicity of CeO2-NPs with polymer coatings in of different charge in coelomocytes of Eisenia fetida earthworms. The CeO2-NPs (2-5 nm primary particle diameter) were coated with dextran to confer a neutral charge (DEX-CeO2(-)), diethylaminoethyl dextran to confer a positive charge (DEAE-CeO2(+)) and carboxymethyl dextran to confer an negative charge (CM-CeO2(-)). The range of exposure concentrations were 0.02-1562.5 mg Ce/L. The coelomocytes were exposed ex situ for 1 h for each treatment. Then, the transcriptions levels of genes associated with stress (catalase and heat shock protein 70) were determined by qRT-PCR. In addition, cytotoxicity and genotoxicity were determined by using tripan blue assay and comet assay respectively. The responses varied significantly among exposure concentration and charge of polymer coatings. The results showed that positively charged DEAE-CeO2 (+) were more toxic that negative and neutral CeO2-NPs. The results show that initial surface chemistry had a profound impact on the toxicity of CeO2-NPs to coelomocytes.

MO405 The uptake of pristine and aged silver nanoparticles by wheat, Triticum aestivum, in a soil exposure
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It is expected that most nanoparticles (NPs) which reach the soil will not be in their pristine form but instead will have been transformed by the environment (e.g., sulphidisation of Ag in waste water treatment processes). This will greatly influence the form of NP to which soil organisms are exposed and their ultimate bioavailability. The bioaccumulation of NPs inside the organisms can govern their fate and transformation in the environment; and uptake studies can give insight into how organisms act as sources and sinks for NPs in food webs. Most data currently available are for pristine Ag NPs, and consequently the difference in the bioavailability of the aged forms, predominantly Ag2S, is uncertain. The aim of this study is to compare the uptake kinetics of Ag NPs, both pristine (PVP coated Ag NPs, 20 and 50 nm) and aged (Ag2S, 20 nm), in the crop species, wheat, Triticum aestivum. Wheat plants were exposed from seed to each of the NPs at two nominal concentrations of Ag, 3 and 10 mg Ag/kg, in the soil Lufa 2.2. Samples were collected at five time points over the 42 day post-emergence exposure period. The growth rate, Ag accumulation and the translocation from root to shoots were determined. The toxicokinetic parameters of the Ag uptake in the roots and shoots were calculated using total soil concentration and soil pore water concentrations as metrics of exposure. Pore water was collected at all sampling points and at the end of the exposure period pore water was ultra-filtered as a measure of the dissolved Ag in the pore water. The accumulation of all silver forms was greater in the roots, with only a small fraction transported to the shoots. The uptake of Ag2S was lower compared to pristine Ag particles but there was no difference between the uptakes of the two pristine Ag particles. This study shows that environmentally relevant forms of Ag NPs are bioavailable to plants and show different uptake kinetics than the pristine forms.

MO406 In vitro effects on Dendrobaena veneta coelomocytes of Ag and TiO2 nanoparticles before and after wastewater treatment processes
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The majority of nanomaterials (NMs) used in commercial applications are likely to enter the wastewater stream and reach wastewater treatment plants. In many countries, wastewater effluent and sewage sludge are discharged in aquatic systems for reuse or applied on agricultural land, however, the transformation of the particles and the potential effects on the aquatic environment are poorly understood. Recent studies have shown high association of NMs with sewage sludge, therefore soils can be a sink for NM pollution making terrestrial organisms vulnerable. The main aim of the study is to understand the transformation of NMs during wastewater treatment processes and to evaluate the potential environmental hazard of aged particles compared to pristine ones. In this study, coelomocytes (primary immune cells) isolated from the epigean earthworm Dendrobaena veneta are used as a model to assess the effects of Ag and TiO2 NPs. Initial investigations focus on Ag (PVP coated, 25 nm, nanoComposix) and TiO2 particles (uncoted anatase, nominal primary size of 5 nm, NM-101, JRC) and their mixture, to better understand their uptake, interaction with coelomocytes and subsequent cellular effects. Moreover, a lab-scale wastewater treatment system is used to study the transformation of Ag and TiO2 NPs through biological wastewater treatment processes, and the potential effects of the aged particles through biosolids application is evaluated. Extensive characterization of the particles in exposure media is performed with dynamic light scattering (DLS), single particle-Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM). Short-term and long-term exposures to Ag and TiO2 NPs were performed on the sludge containing Ag and TiO2, NPs. The effects of the pristine and aged particles on the metabolic activity, lysosomal integrity, reactive oxygen species formation, immune response and coelomocyte population are assessed. Moreover, nanoparticle uptake and intracellular localisation are evaluated with TEM and sp-ICP-MS.

MO407 Differential biomarker responses of Daphnia magna to pristine and wastewater borne silver nanoparticles
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The growing use of silver nanoparticles (AgNPs) as antibacterial agents in a variety of products have raised the need to assess their environmental impact. The ever-growing application of AgNPs leads to their introduction into wastewater treatment plants (WWTPs) via sewer systems. During treatment, AgNPs are mainly retained in sewage sludge but part of transformed AgNPs is released into the environment. This study aims at investigating the effect of pristine and wastewater borne AgNPs (TEM), which are markers of nanomaterials, on physiology, toxicokinetic and toxicodynamic effects in Daphnia magna. Daphnids were analysed for changes in acetylcholinesterase (AChE), glutathione S-transferase (GST), catalase (CAT), lactate dehydrogenase (LDH) activities, and anaerobic metabolism in a WWTP effluent. The dispersant used in ASTM (4% w/w of each Tagat® TO and TWEEN® 20) showed both significant decreases (AChE, GST, CAT) and increase (LDH) of enzymatic activities in dispersant-control relatively to negative-control, suggesting deleterious effects of dispersant to daphnids. Biomarker responses to NM-300K were more marked when added to effluent comparatively to ASTM, especially with higher concentrations. There was a significant decrease of AChE activity in effluent and (25 and 75 µg/L) and ASTM (125 µg/L) media, which implies impairment of control and modulation of neural transmission in these experimental conditions. The significant increase of GST and CAT activities at 100 and 125 µg/L in effluent, respectively, suggest oxidative stress. The significant increase of LDH activity in effluent media at 125 µg/L in effluent suggests an increase in anaerobic metabolism and higher stress for daphnids. Unfortunately, there was a significant decrease on LPO at 125 µg/L in ASTM, which could be explained by a decrease of synthesis of total lipids. This study shows that (i) the response of biomarkers to used dispersant agent highlights the need for further study on its effects in organisms prior to its application, in order to understand the AgNPs behaviour in standardised test media and (ii) there is a distinct biomarker response-pattern in daphnids exposed to WWTP effluent containing NM-300K and ASTM supplemented with pristine NM-300K. In

MO408 Outlining the behaviour and ecotoxicology of biomedical nanoparticles in natural waters
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BioNano Interactions; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences
Engineered nanoparticles (NPs), given the multitude of uses, can be released in aquatic environments, both intentionally and accidently. To date there is no shortage of studies concerning the environmental fate and ecotoxicity of widely used NPs, such as titanium and silver oxides. However, much less is known about NPs manufactured in novel cutting-edge applications as nanomedicines. In this study we investigated five biomedical NPs, namely polymeric polystyrene (PSNH), europium doped-cerium oxide (CeO$_2$@Eu), carbon dot-doped silica (SiC@C), and polyanethlyleneglycol-functionalized silica (SiO$_2$-B and SiO$_2$-PEG), respectively, and we assessed their behaviour and biological impacts in natural river- (NRW) and seawater (NSW). Hydrodynamic sizes were monitored for 30 days by dynamic light scattering (DLS) and showed remarkable differences in NRW compared to NSW of both bare and PEGylated SiO$_2$ NPs. In fact, SiO$_2$ NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PS-NH$_2$, CeO$_2$@Eu and SiC NPs did not show such a clear distinction between the two natural media, reaching micrometric sizes after 24 h. In order to address sedimentation phenomena, normalized derived count rates (DCR) were used to estimate the absolute number of dispersed NPs in the both media. SiO$_2$B and SiO$_2$-PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected form suspensions after 24 h.

On the contrary, no such difference was observed for PSNH$_2$, CeO$_2$@Eu and SiC NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectroluminescent assays. SiO$_2$-based NPs bioaccumulation studies were performed by feeding the freshwater clam Corbicula fluminea with transmission electron microscopy (TEM) imaging, while PSNH$_2$ maintained an intact structure in NRW and NSW. Finally, algal growth inhibition tests were performed using freshwater and marine microalgae (OECD. 1994). PSNH$_2$ and CeO$_2$@Eu were toxic in the OECD synthetic freshwater media only, while the remaining NP types did not show any sign of toxicity. A significant p < 0.05 reduction in PSNH$_2$ and CeO$_2$@Eu NPs toxicity was observed repeating the tests in NRW, while again no toxicity was confirmed in NSW. Altogether, our results provide a realistic insight in the fate and toxicity of diverse NPs, also highlighting the importance of testing complex natural matrices for a more realistic risk assessment.

MO409 Development of a method for the analysis of nanoparticles in the freshwater clam Corbicula fluminea

Testing nanoparticles (NMs) under environmentally relevant conditions is an important aspect regarding the risk assessment of nanomaterials that enter the water cycle. To this end, the interaction of NMs with aquatic eukaryotes is becoming more and more important. NMs have been carried out with the freshwater clam Corbicula fluminea. Silver nanoparticles (AgNPs) and TiO$_2$-NPs were chosen as model particles. The aim of this project was to detect and characterize MNMs in the tissue of animals collected at the end of the exposure period. For the analysis and characterization of nanoparticles in the tissue samples, two promising analytical methods were applied: (i) single particle inductively coupled plasma mass spectrometry (spICP-MS); (ii) Flow-Field-Flow-Fractionation (Flow-FFF) coupled to ICP-MS. The spICP-MS is based on direct particle counting, which is commonly used for ecotoxicity studies. Previous studies with this test system showed that silver (Ag) from silver NMs is accumulated by H. azteca exposed to model STP effluents. However, the pathway of Ag accumulation, via ingested test particles, Ag and/or biocatalytic breakdown of dissolved silver, is still unknown. To further elucidate the uptake pathway of silver from model STP effluents, two groups of H. azteca with five animals each were placed in a single test vessel. The two groups were separated by a stainless-steel strainer. One group was fed contaminated sludge from model STPs, loaded on glass fibre filters. The second group, located in the stainless-steel strainer, was fed uncontaminated control STP sludge. This led to direct contact of the test sludge containing Ag NMs. The study was carried out with five replicated test vials with two groups of amphipods each. Water samples were taken within the strainers to measure the silver content in the media and to prove that the animals fed control sludge were not in contact with Ag NMs potentially released from the contaminated sludge. After an exposure period of 7 (21) days Ag content of the water and animal samples collected at the end of the exposure period was measured by ICP-MS or ICP-OES to determine the accumulation of Ag in both groups. The presence of NMs in the animals was examined by high-resolution transmission electron microscopy (TEM) and methods of correlative microscopy. The derived accumulation factors and the results of the TEM investigations allow to evaluate the contribution of particulate and dissolved Ag to the accumulation of Ag from STP effluent.

MO412 Ecotoxicity of silica and silver nanoparticles (ENPs) on hyphoric copepods as a function of their bioavailability by dissolved organic matter (DOM) and water hardness of environmental samples
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The development and production of engineered nanoparticles has increased the potential for interactions of these nanomaterials with aquatic and terrestrial environments. ENPs are one of the commonly used particles in nanotechnology-based products. They are used in a wide spread application such as chemical industry, cosmetics, medicine and agriculture. The ENPs predicted concentrations using market study production estimates based on life cycle release models and measurements, in biosolids, was 5 - 123 and 0.02 – 2.01 mg/kg and, in...
liquid effluents 0.03 - 6.74 and 0.003 - 0.26 µg/L for Si and Ag NPs respectively. Environmental exposure models have shown that soils and sediments can provide important reservoirs of these nanomaterials, especially in the presence of high concentrations of DOM. These such as the humic substances found in water, sediment, and soil, are one of the substances capable of interacting with ENPs. To understand and assess the effects of NPs on the environment, should be well established quantitatively the concentration-response relationships. Also, to know what environmental variables regulate their bioavailability and, thus, their toxicity. Designed studies are therefore required in order to understand the fate, transport, stability, and toxicity of nanoparticles. By the other hand, there are not many studies about the effect of ENPs on hygroscopic copoed species and less related with DOM concentrations. The hydroporphic zone is a region underneath streams that integrates surface and groundwater. Its location is central to biogeochemical linkages between the riparian zone, dissolved nutrients, and benthic biota. Even if in this DOM sources are relatively constant, biogeochemical processing within the hydroporphic zone resulted a DOM pool that is temporarily dynamic regarding its composition and concentration. In this study we evaluated how DOM concentrations and water hardness are related with the acute ecotoxicity of Si and Ag NPs on the survival of *Metaphycus pacificus* a widespread hydroporphic species. Toxicity of AgNps was related with DOM concentrations and showed a non-significant Beta for water hardness. On the contrary, for SiNps, DOM and water hardness quantitative relationships were negatively correlated with ecotoxicity on this freshwater invertebrate.

MO413 Long-term exposure of ZnO nanoparticles to freshwater microalgae cultivated in batch and semi-continuous mode A.F. Arvanitidou, F. Androu, I. Manariotis, University of Patras / Civil Engineering Nanoparticles (NPs) have always existed in the physical environment. The rapid development of commercial applications involving the use of a large variety of synthetic nanoparticles has resulted in the introduction of higher amounts of nanoparticles in the environment. As the use of NPs increases, their effect to the coastal food chain and ecosystems is crucial. The aim of this work was to investigate the toxic effect of zinc oxide (ZnO) NPs on freshwater microalgae in batch and semi-continuous feeding mode for longer period than the time used in typical toxicity tests. *Scenedesmus rubescens* was selected as model microorganism since it is a common freshwater microalgae. *S. rubescens* exposed to ZnO NPs concentrations varying from 0.081 to 810 mg/L for 28 days in batch mode conditions, while in semi-continuous mode it was exposed to 0.081 mg/L of ZnO NPs. The cultures were grown in modified Blue-Green 11 medium (BG-11). The effect of continuous flow was associated with synthetic wastewater mimicking a growing zone, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibitory concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of *S. rubescens* was greater in the presence of ZnO NPs, and the lipid content was higher.

MO414 Effects of sunscreen-derived TiO2 nanoparticles on freshwater and marine organisms M. Vannuci-Silva, UNICAMP / Institute of Biology; S. Cadore, University of Campinas; G. Umbuzeiro, School of Technology, UNICAMP / LÆG The relatively recent development of engineered Ag nanoparticles has expanded significantly. Silver nanoparticles (AgNP) tend to agglomerate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Amphipods, like *Parhyale haawaiensis*, are deposit-feeding species ecologically relevant, becoming an excellent model for ecotoxicology studies. In addition to the traditional toxicity studies, internal doses determination, for example in the haemolymph, can provide information on the level of exposure to toxic metals. The aim of this study was to investigate Ag concentration in the haemolymph of a tropical marine amphipod *Parhyale haawaiensis* exposed to food containing AgNP and AgCl. We hypothesized that the actual AgNP could be absorbed by the gut leading to a higher amount of Ag in the haemolymph when compared to food containing AgCl. Silver nanoparticles < 100nm (Sigma Aldrich) or elemental Ag (from AgCl, Sigma Aldrich) were incorporated into feed in form of 4 different fish feed treatments. In contrast, particles were prepared using a thin glass capillary, weighted and analysed. Three pooled samples of 4 amphipods, like *Parhyale haawaiensis*, were analysed. In the case of AgCl, AgNP treatment we found to be more stable in seawater after the aging process, which can affect its impacts on exposed organisms.

Silver concentration in the haemolymph of a tropical marine amphipod fed with silver nanoparticles and silver chloride M. Vannuci-Silva, UNICAMP / Institute of Biology; S. Cadore, University of Campinas; G. Umbuzeiro, School of Technology, UNICAMP / LÆG The relatively recent development of engineered Ag nanoparticles has expanded significantly. Silver nanoparticles (AgNP) tend to agglomerate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Amphipods, like *Parhyale haawaiensis*, are deposit-feeding species ecologically relevant, becoming an excellent model for ecotoxicology studies. In addition to the traditional toxicity studies, internal doses determination, for example in the haemolymph, can provide information on the level of exposure to toxic metals. The aim of this study was to investigate Ag concentration in the haemolymph of a tropical marine amphipod *Parhyale haawaiensis* exposed to food containing AgNP and AgCl. We hypothesized that the actual AgNP could be absorbed by the gut leading to a higher amount of Ag in the haemolymph when compared to food containing AgCl. Silver nanoparticles < 100nm (Sigma Aldrich) or elemental Ag (from AgCl, Sigma Aldrich) were incorporated into feed in form of 4 different fish feed treatments. In contrast, particles were prepared using a thin glass capillary, weighted and analysed. Three pooled samples of 4 amphipods, like *Parhyale haawaiensis*, were analysed. In the case of AgCl, AgNP treatment we found to be more stable in seawater after the aging process, which can affect its impacts on exposed organisms.

Silver nanoparticles affect the early development of *Tisbe battagliai*: pristine vs aged particles A. Georganopoulou, Norwegian Institute for Water Research NW; K. J. Farkas, SINTEF Ocean / Institute of Environmental Engineering; K. Landau, Norwegian Institute for Water Research; P. A. Carvalho, SINTEF Materials and Chemistry; A. Booth, SINTEF Ocean / Environmental Technology; A. Macken, NIVA / marine pollution Silver and titanium nanoparticles are used in numerous consumer products and applications and they are likely to enter wastewater streams, reach wastewater treatment plants and aquatic systems through wastewater and effluent discharge. Nanomaterials undergo transformations in different matrices altering their fate, behaviour, bioavailability and toxic potential that could differ greatly from the pristine counterparts. There are challenges on the detection and quantification of nanomaterials at environmentally relevant concentrations in complex media and matrices such as whole organisms. Moreover, studies on uptake and effects of transformed particles on marine species is largely lacking. The aim of the present study is to better understand the transformation of Ag and TiO2 NPs in wastewater and assess the uptake, bioaccumulation and subsequent developmental effects of pristine and transformed particles on the marine organism *Tisbe battagliai*. In this study the harpacticoid copepod *Tisbe battagliai* was selected as a relevant marine species and the effects on the naupliar development was assessed over an exposure period of 6 days. The mortality and the developmental stage of the organisms was assessed daily. Initial investigations focus on the study of Ag (titanium coated in 5 nm, nanoComposix) and TiO2 particles (nominal primary size of 5 nm, NM-101, JRC) and their mixture. Moreover, the particles were aged in synthetic wastewater (for 4 hours under stirring conditions) and the effects of “aged” particles on the uptake, bioaccumulation and naupliar development was assessed. Extensive characterization of the particles in synthetic wastewater, seawater and exposure media was performed with dynamic light scattering (DLS), ultraviolet–visible spectroscopy (UV–VIS), single particle–Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM). Moreover, nanoparticle uptake, bioaccumulation and intracellular localisation is evaluated with TEM and sp-ICP-MS. Results showed that the both particles types were stable in seawater and no dissolution was observed. In contrast, particle concentrations decreased over time in seawater, which was likely due to both dissolution and aggregation for Ag, and aggregation in TiO2. TiO2 particles were found to be more stable in seawater after the aging process, which can affect their impacts on exposed organisms.
haemolymph causing this increase in Ag content. More studies are required to verify the Ag form present in the haemolymph and how it will induce damage in the exposed organisms.

MO417 Toxic effects of multi-wall carbon nanotubes on bivalve species: A. Ciervo, S. Iavicoli, Italian Workers Compensation Agency & Centre for Mechanical Technology and Automation (TEMA), University of Aveiro / Department of Biology & CESAM, Portugal; C. Pretti, Department of Veterinary Sciences, University of Pisa, San Piero a Grado; E. Figueira, University of Aveiro / Biology CESAM, Portugal; R. F. Chielli, University of Aveiro / Department of Biology & CESAM; F. Chielli, University of Aveiro 3810-193, Portugal; G. C. Pretti, University of Aveiro / Department of Biology & CESAM; R. Feitas, University of Aveiro / Departamento de Biologia CESAM

The use of carbon nanomaterials (CNMs) has increased rapidly in the last years, mainly due to their important properties such as electromagnetic, optical, catalytic, mechanical, thermal, and pharmokinetics. Currently, carbon nanotubes (CNTs) are one of the most important and commercially used CNMs. CNTs are hollow graphene cylinders that are microns to millimeters in length and can be divided into single-walled (SWCNTs) with a diameter of 0.7 to 3 nm, and multi-walled (MWCNTs) with a diameter of 10 to 25 nm. CNTs are engineered with a wide variety of core structures and surface functionalizations that change their chemical and physical properties to enhance their suitability for different industrial applications. However, despite of the large array of available CNT configurations, their impacts on aquatic organisms, especially on invertebrate species, are still limitedly known. To our knowledge, no information is available on how surface chemistry alteration (functionalization) of CNTs may impact the toxicity of these CNTs. The main reason for this is that surface treatment (28 days) to unfunctionalized MWCNTs (Ni-functionalized) in comparison with functionalized MWCNTs (f-MWCNTs), by introducing polar groups such as carboxyl groups (-COOH) in order to achieve better dispersibility in water, were evaluated in the Manila clams Ruditapes philippinarum, one of the most dominant bivalve of the estuarine and coastal lagoon environments. Alterations induced in clams’ oxidative status, neurotoxicity and metabolic capacity were performed. The results obtained clearly showing that both Ni-MWCNTs and f-MWCNTs were able to generate oxidative stress in the exposed clams and were also responsible for changes in organisms’ metabolism (expressed in alteration of energy reserves) and neurotoxicity induction in R. philippinarum, however greater impacts were caused by the functionalization of metal nanoparticles (AuNPs) (100 nm, 50-100 nm, and 1000 nm size 5-8 nm) furnished by JRC. NM characterization showed different degrees of ENMs in the environment may relate to intrinsic particle properties such as size, shape, surface coatings and hydrophobicity. In future research we will investigate the impact of the suspended solids and the overall effect of the transformations on the aggregation behavior of the ENMs upon their introduction to different environmental mediums (e.g., water, soil). In simulating the discharge of the aged ENMs to the environment, we provide context to explain differences in both the toxicity and oxidative status of multi and single walled silica NPs and oxidative DNA damage for NM101, correlated with the proinflammatory IL-6 cytokine induction, probably due to its smaller size, higher agglomeration tendency and capacity to induce ROS. This study is partially financed by FP7-NANOReg project, Grant n. 310584.

MO419 Transformations of engineered nanomaterials during wastewater treatment: the role of engineered surface coatings and the impact on environmental fate M. Surette, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical and Biological and Environmental Engineering; R. Kaegi, Eawag - Swiss Federal Institute of Aquatic Science and Technology, Switzerland

Previous research has highlighted the importance of particle-particle interactions in controlling the environmental fate of engineered nanomaterials (ENMs). Yet our ability to accurately predict the outcome of these interactions within environmental systems is still limited. One obstacle is the inherent complexity of these interactions which depend on several factors, including the properties of the ENM, hydrophilicity and hydrophobicity, and oxidative transformation processes (e.g., over-coating via natural macromolecules, surface coating displacement, etc.). When considering the pathways by which ENMs may be released to the environment, wastewater treatment plants (WWTPs) not only act as gateways controlling the release of ENMs but they may also serve as reactors adjusting the properties of the ENMs. Therefore, to improve our understanding of ENM interactions within environmental systems we must first understand the extent to which ENM properties are altered within WWTPs. To investigate the development of a protocol that simulates the transformations or ‘aging’ ENMs experience within a WWTP. The initial focus is on the effect of the dissolved components within the wastewater medium and whether ENMs with initially dissimilar properties will have similar properties after aging. To accomplish this, different types of advanced nanomaterials (including AuNPs and TiO2 NPs) with different engineered surface coatings were selected as model ENMs. A series of batch reactors, each containing a sample from a different stage in a WWTP, were used to assess the impact of each stage on the ENMs. Each wastewater sample was first filtered to remove suspended solids and then dosed with a single type of model ENMs. Each reactor was mixed and aliquots were collected over time. The aliquots were then analyzed by a variety of techniques to determine the impact of the media on the properties of the ENMs, including size, surface charge, stability/aggregate structure, and hydrophobicity. Ultimately, this will help refine our understanding of ENM environmental fate.

MO420 Freshwater sediments as an environmental reactor: defining biologically relevant fate parameters to provide context for nanomaterial bioaccumulation R. Cross, University of Exeter; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; T.S. Galloway, University of Exeter / Biosciences

As the field of nanotechnology matures there is a call for the research focus to progress from hazard identification to more ecologically relevant assessments of the risk that engineered nanomaterials (ENM) pose as they undergo a range of transformations in the environment. This will require test designs prioritising environments most at risk of contamination, and which not only measure ecologically relevant endpoints, but also characterise the fate, transformations and behaviours of particles within the test system, providing the context for differences observed between treatments. Freshwater sediments present an ecosystem in need of further research, as these are predicted to be major sinks of ENMs entering the aquatic environment though waste water treatment and terrestrial pathways during material production, use and disposal. Whilst freshwater sediments have been identified as an ecological compartment at risk of contamination, very little is known about the fate of these ENMs entering these sediments. We present a simple separation method to isolate the colloidal (< 200 nm) and dissolved (< 1kDa) fractions of the sediment pore water, which can be run alongside biological exposures. This provides the context for how these biologically accessible fractions of ENMs in the sediments may relate to intrinsic particle properties such as size, core composition and coatings. Using cerium oxide (CeO2-NP) and silver nanoparticles (AgNP) routes we show that differences in the ENMs in the freshwater sediment dwelling worm Lumbriculus variegatus. By following the fate of these particles in the solid bound, colloidal and dissolved fractions of the sediment, we provide context to explain differences in both the route and extent of uptake of these materials by the worm. This poster presents the successful application of this method to investigate the implications different sediments may have on the fate of these ENMs. The uptake of these materials into different routes (electrostatically stabilised citrate and sterically stabilised PEG coatings) have upon the route of uptake of CeO2 and AgNPs and transformations they undergo during sediment exposures. Accumulation of CeO2 via dietary uptake is linked to their strong associations to the solid fraction of
the sediment and lack of dissolution (< 1% of spiked cerium was extractable with water). Transdermal uptake of AgNP was attributed to dissolved silver in the pore waters and uptake of soluble silver, potentially through localised dissolution of particles at the worms’ surface.

MO421 Evaluating the role of TiO2 nanoparticle surface transformations on transport and toxicity

A.R. Deline, Oregon State University / Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering

Titanium dioxide nanoparticles (TiO2 NPs) have great potential for use in a variety of commercial and environmental applications, including the photocatalytic treatment of contaminants. While processes like microbial inactivation and the generation of reactive oxygen species (ROS) have been studied under a variety of irradiation and water chemistry conditions, there exists limited mechanistic insight as to how these processes are related to the molecular-level surface transformations that may occur under different environmental conditions. This study is using surface-sensitive characterization techniques, including x-ray photoelectron spectroscopy (XPS), to examine the impact of UV irradiation, temperature, and water chemistry exposures on the metal oxide surfaces of both pure anatase and mixed anatase-rutile TiO2 NPs. Initial XPS studies of the impact of simulated solar irradiation revealed that solar irradiation resulted in a decrease in the aliphatic carbon present on the TiO2 surface and an increase in the oxygen-bonded carbon, with no observable effect on the oxidative properties of the metal oxide. Additional studies will examine surface chloroplatinic acid treatments for both primary and secondary solar irradiation. Through time, our Fresnel lens to increase the irradiation intensity and solution temperature. The relationships between these molecular-level surface properties and the extrinsic properties of the TiO2 NPs are being further explored using a suite of functional assays. Assays that have been optimized for the characterization of TiO2 NPs in this study include methylene blue dye degradation (photocatalytic activity), rose bengal dye photoconversion (Activity), and fluorescein dye conversion (ROS generation). Ultimately, changes in the properties of the TiO2 NPs will be compared to larger scale environmental behavior, allowing for a better understanding of the specific role that surface structure plays in nanoparticle transport and toxicity.

MO422 Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles

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Organic matter (OM) released to the environment by engineered nanomaterials (ENM) will inevitably come into contact with different types of dissolved organic matter (DOM). It has been shown in a large number of studies that DOM influences the colloidal properties of ENM, which in turn impact subsequent transport and transformation processes. Sulfidation, as an important environmental transformation process, has significant implications for the fate and the ecological effects of NPs. Studies that evaluate the influence of DOM on the nanoparticles’ sulfidation reaction kinetics and the reaction pathway are very scarce. For copper oxide nanoparticles (CuO NPs), the sulfidation reaction and its kinetics have been described in detail. However, the influence of DOM on this reaction has not been investigated, yet. Due to their high content of bisulfide (HS\(^-\)), wastewater systems represent major sulfidizing compartments, whereas the marine environment contains low concentrations of sulfides and humic substances. In this study, we therefore selected three organic model compounds (Bovine serum albumin (BSA), model protein), Alginate (model polymer polyacrylcarboxylic acid (natural organic matter analogue)) and investigated their influence on the sulfidation of CuO NPs. All experiments were conducted in solutions buffered to pH 8 at concentrations of 1.3 mM CuO and 4 mM HS\(^-\). Variable amounts of the organic compounds were added to reach final concentrations of 10, 100 and 1000 mg L\(^-1\). Reacted CuO NPs were collected at selected time points and characterized using Cu K-edge X-ray Absorption Spectroscopy (XAS). In addition, selected samples were characterized using analytical electron microscopy. XAS analyses revealed that at a concentration of 10 mg L\(^-1\), none of the selected organic compounds affected the sulfidation rate and observed reaction products. However, at BSA concentrations >100 mg L\(^-1\) a reduction of the reaction rate was observed. In addition, at these high concentrations, BSA hampered the recrystallization of amorphous CuS to covellite. Electron microscopy also showed that in the presence of BSA, amorphous CuS was the dominating particle type. Our results show that at high concentrations, processes such as the aqueous phase both the reaction kinetics and the reaction pathway of the CuO sulfidation. In real municipal wastewater, however, lower protein concentrations and thus a complete sulfidation of the CuO NPs can be expected.

MO423 Evaluating spICP-TOF-MS for Exploring Environmental Nano-scale Processes

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The advent of single particle ICP-MS (spICP-MS) has helped advance the field of nanomotology, specifically at concentrations and in matrices that are environmentally relevant. However, the concentration of naturally occurring nanoparticles (NNPs) and nanominerals far outweigh the expected released concentrations of engineered nanoparticles (ENPs), making their detection by single element spICP-MS and their subsequent risk assessment a challenge. The introduction of spICP-time of flight mass spectrometry (spICP-TOF-MS) has the potential to overcome these challenges, as elements are detected quasi-simultaneously at dwell times of 46µsec, covering nearly the entire atomic mass range (7-250 m/z). By examining differences in the chemical composition on a particle-by-particle basis, NNPs and ENPs can be differentiated, and geochemical processes occurring at the nano-scale can be explored on an individual particle basis. In order to establish this technique, 125I-NPs were used to validate the efficiency and accuracy of the analyses, several multi-element and multi-isotope nanoparticles were analyzed using traditional spICP-MS (with quadrupole mass filtering) and with spICP-TOF-MS. The precision and accuracy for particle sizing and counting were evaluated for each technique for a range of elements to explore the advantages and potential limitations of these techniques as the apply to environmentally and geochemically relevant systems. To illustrate the advances made in multi-element monitoring by time-of-flight, single particle analyses were performed on both a quadrupole ICP-MS and an ICP-TOF-MS, and using 3ms and 100µs dwell times on both instruments. Particles analyzed consisted of mixtures of well-defined AuAg core-shell NPs with Au and Ag only NPs, polydisperse ceramic NPs with well-defined chemical compositions, and environmentally relevant colloidal suspensions containing ENPs. These systems were selected for both their relevance for both environmental impact and their ability to assess the efficacy of spICP-TOF-MS as a characterization technique. spICP-TOF-MS demonstrates considerable advantages over traditional spICP-MS and has the potential to examine the geochemical realm on an individual particle basis. The further development of this technique may also lead to a better assessment of ENP exposure in test systems and nature, improving on environmental risk assessment and gaining a better understanding of ENP interactions with naturally occurring colloids.

MO424 Assessing potential risks of Nanodrugs and their delivery systems in fish using Light Sheet Microscopy

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Nanotechnology applications have increased dramatically in recent years including in the pharmaceutical sector. The unique properties of nanoparticles have been exploited in medicine in both drug development and drug delivery. Their small size and capability for manipulation and functionalisation allows for great improvements in drug efficacy. Nanomedicines can cross a wide range of biological membranes and barriers (including the blood brain barrier facilitating the diagnosis and treatment of life threatening diseases such as cancer. Although nanotechnology may help to reduce the toxicity and side effects of drugs, the actual carriers themselves may also have the potential for inducing toxic effects, depending on their composition. This raises the need for safety evaluations of these drug delivery systems both in patients, but also with respect to their potential for environmental impact. Very little is known regarding the potential impacts associated with the release of these nanodrugs or their carrier systems into the environment, although some studies have begun to investigate the potential toxic effects of various nanoparticle shapes and coatings in aquatic organisms. Using various sizes of gold nanoparticles (between 10 and 100nm in diameter) with a non-reactive methyl polymer and fluorophore coating, we have traced their uptake and tissue partitioning using a casper mutant zebras and light sheet microscopy. We have constructed a light sheet system based on the OpenSPIM platform, (SPIM - Selective Plane-illumination Microscopy) which allows us to create 3D images and 4D videos in real-time. Using this rapid image acquisition technique we showed a size selective uptake of the nanoparticles into the kidney and minimal uptake in other tissues. Depuration studies indicate a steady loss of the gold nanoparticles from the pronephric kidney over time. We also investigated for biological responses using specific zebras transgenic lines for oxidative stress and kidney function. We are now investigating the effect different coatings and functionalisations have on the uptake and distribution of gold nanoparticles in the larval zebrafish ultimately with the aim of beginning to define the potential for this important new group of medicines for having an environmental impact on fish.

MO425 SETAC Nanotechnology Interest Group

C. Svendsen, CEH, Wallingford / Pollution and Ecotoxicology

Hydrophobic Chemicals and Mixtures: Reliable Investigations on their Environmental Fate and Effects (P)

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MO426
Effect of ageing on polycyclic aromatic hydrocarbon composition of biochar
G. Sigmund, Technische Universität München / Chair of Analytical Chemistry and Water Chemistry; T. Bucheli, Agroscope ART / Environmental Analytics; I. Hilber, Agroscope / Environmental Analytics; T. Hüffer, M. Kah, T. Hofmann, University of Vienna / Department of Environmental Geosciences

The influence of ageing on biochar properties has been investigated by comparing three fractions of biochars, thermally aged by either \( H_2O \) thermal oxidation or horseradish peroxidase enzymatic oxidation. In addition, a field-aged counterpart for one of the biochars was recovered from an agricultural field site, four years after application. Biochar bulk properties showed only minor changes following both artificial and field ageing, indicating high biochar stability. Concentrations of the 16 US EPA PAHs were measured in all of the biochars and a contaminant trap was used to investigate the effect of ageing on their bioaccessibility. The concentrations of total and bioaccessible PAHs ranged from 4.4 to 22.6 mg/kg and 0.0 to 9.7 mg/kg, respectively. Concentrations of the 16 US EPA PAHs decreased following field ageing, but the proportion of low molecular weight PAHs increased. The observed changes in PAH composition with field ageing can partially be explained by uptake from the surrounding soil. In addition, size discriminatory intra-biochar transfer processes also contributed to the changes in PAH composition. To better understand changes in PAH composition with ageing, an additional broad range of alkylated PAHs was also analyzed in selected samples. Our results show that the tested artificial ageing protocols are unable to approximate the changes in PAH composition resulting from field ageing. Nevertheless, total and bioaccessible PAH concentrations decreased for both artificially and field-aged biochars, indicating that PAH release decreases with ageing. Therefore, well-produced biochars that meet European Biochar Certificate (EBC) and International Biochar Initiative (IBI) quality thresholds for total PAH concentrations are unlikely to present a risk with regard to PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).

MO427
Field testing of a new calibration approach for silicone passive samplers: Comparison of the concentration ratio method using samplers of different thicknesses with the PRC approach
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Silicone passive sampling is a common method for sampling bioavailable concentrations of waterborne hydrophobic pollutants in the environment. Often silicone passive samplers have to be used in kinetic mode and sampler calibration is unavoidable. Most commonly, exchange kinetics are derived from the release rates of performance reference compounds (PRCs) spiked into the sampler prior to usage. Unfortunately, PRCs can be expensive and are not always available for all compounds. Due to these challenges, a complementary calibration approach using passive samplers of different thicknesses has been developed and investigated in lab and field. This study describes the testing of the approach in situ out in the field. The sampling location was a storm water retention pond collecting storm water run-off from a motorway. The pond has two basins, one of which is equipped with a Floating Treatment Wetland (FTW) for cleaning the run-off. Two sets of duplicate samplers with 3 different thicknesses were installed in the inflow, after the FTW and in the reference basin without a FTW. One set of samplers was taken out after three weeks and the second after five weeks. These were extracted and analyzed for PAHs, with the concentration ratios for the different thicknesses used to calculate the field dissolved concentrations. All samplers had been additionally loaded with PRCs, with the decreases also used to calculate the field levels. These were compared to the results from the concentration ratio approach, underlining its suitability as a complementary calibration method and its application domain.

MO428
Use of biochar for hexachlorocyclohexane sorption: a mechanistic approach
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Hexachlorocyclohexanes (HCHs) are halogenated compounds composed of 4 main isomers: \( \alpha \)-HCH, \( \beta \)-HCH, \( \gamma \)-HCH and \( \delta \)-HCH, which differ for their tridimensional structure. Commercial HCH in technical grade is a mixture of these isomers. HCH has been extensively used as a pesticide despite the fact that only \( \gamma \)-HCH (lindane) has insecticide properties. HCHs' toxic, carcinogenic, teratogenic and neurotoxic effects have been reported in humans; and the HCHs have a clear tendency to accumulate in the environment. For these reasons, HCHs are contaminants of water bodies concentration. Physical and chemical removal techniques have been used to remove HCHs in aqueous solution, among these, adsorption is the most common used one. Biochar (BC) is a carbonaceous material that is a promising sorbent amendment material due to its high adsorption of organic and inorganic contaminants, and to its low cost. In this study three standard biochars, from digestate (BCd), from greenhouse tomato waste (BCtw) and from durian shell (BCsh), have been used as sorbent materials for the HCHs removal from water. The BCs used cover a wide range of surface area (5.4 - 328.6 m² g⁻¹), pore volume (5.1 - 186.6 cm³ g⁻¹), pore dimension (1.05 - 5.85 Å), pyrolysis temperature (400 – 700 °C) and surface properties (including iron content). Batch isotherm tests were carried out in deionized water with the single isomers and the mixture of \( \alpha \)-, \( \beta \)-, \( \gamma \)- and \( \delta \)-HCH. The HCH concentration was ranged between 1 and 500 µg L⁻¹ in the monocomponent isomers and between 5 and 2000 µg L⁻¹ (total concentration) in the mixture isomers. Polyethylene (PE, 26.0 ± 0.0 mm) was used as a passive sampler for assessing the HCHs concentration in water. The sorption performance of the biochars is related to their physicochemical properties. Preliminary results have shown the adsorption performances are correlated with the BC surface area and iron content, where a higher adsorption is observed as surface area and iron content increase. Clear differences in the behavior of the isomers were observed.

MO429
Development of a Method for Measurement Freely Dissolved Concentrations of Alkylated PAHs Using Solid Phase Microextraction with PDMS Fibers
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Frequently, the total PAH sediment concentration reported for a sample has been based on 16 individual priority pollutants according to the U.S. EPA Method 8310. For pyrogenic sources of PAHs (e.g. incomplete burning processes), the parent PAHs are the predominant species. In contrast, PAHs from petrogenic sources (e.g. crude oil) are dominated by alkyl PAHs. Therefore, the U.S. EPA narcosis model showed that PAHs are more toxic when measured as their alkylated forms. In order to approximate the risk of PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).

MO430
Spatial Distribution of HOCs on the Palos Verdes Shelf Superfund Site
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Hydrophobic organic contaminants (HOCs), such as DDTs, PCBs, and currently used pesticides contaminate soils and sediments all over the world. As they are hydrophobic in nature, these compounds are resistant to both chemical and physical degradation while also having a strong affinity for soil or sediment particles and organic matter. Often, this contamination is due to the historic or current use and manufacture of these compounds, such as the widespread contamination of the Palos Verdes Shelf by DDTs and PCBs, which continue to pose health hazards to organisms. The U.S. EPA narcosis model showed that PAHs are more toxic when measured as their alkylated forms. In order to approximate the risk of PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).
MO431 PAHs in water and surface sediments from Douro River estuary and Porto Atlantic coast (Iberian Peninsula, North Portugal) — Risks for biota and human health? M. Joio Rocha, ICBAS U. Porto, CIMAR CIMAR LA; J.L. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruziero, CIMAR CIMAR LA, Porto, CEF FCTUC U.Ciobana; R. Rocha, ICBAS U. Porto, CIMAR CIMAR LA The study shows the presence of 16 priority PAHs (PAHs) in surface waters from the Douro River estuary and nearby Atlantic seacoast. These areas bath Porto and Gaia cities, widely known by the production/export of the famous Porto wine. This area, besides being highly industrialized, also holds an oil refinery, an important harbour, intense maritime traffic, and recreational marinas. For this study, water samples were taken from four strategic sampling sites, at six different times of the year. These samples were extracted by ultrasound technique (suspended fraction) and solid-phase extraction (dissolved fraction), before their quantitative analysis by gas chromatography—mass spectrometry (GC-MS). Data showed the presence of all analysed PAHs in all samples, which global amounts (Σ21PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≈ 52 μg/g dry weight (dw) in sediments and ≈ 2 μg/L in surface water. In view of the high complexity in PACs compounds (NSO (NORTE2020), through the ERDF. ICBAS – U. Porto. Keywords: PAHs, carcinogenic, estuary, sea, monitoring.

MO433 Occurrence and availability of PACs and total AhR agonists in contaminated soils - Combining in vitro reporter gene assay and chemical analysis with passive sampling and column leaching M. Larson, Oerebro University / Man-Technology-Environment research centre (MTM); M. Lam, RWTH University Aachen; P. van Hees, Oerebro University / MTM Research Center; J. Giessy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and D. Song, UM, Center; M. Kingwall, Oerebro University / Man-Technology-Environment research centre (MTM) Polycyclic aromatic hydrocarbons (PAHs) are common contaminants at industrial sites, and occur as complex mixtures of thousands of PAHs and heterocyclic compounds (NSO–PAFs) among others, collectively referred to as polycyclic aromatic compounds (PACs). The contaminant composition differ widely due to contamination from the surrounding processes despite the high complexity in PAC-contaminated areas, recent risk assessment of PACs is commonly based on chemical analysis of the 16 US EPA PAHs. Consequently, many PACs are unknown. There is an urgent need of improved and applicable analytical methods to assess environmental levels and fate of potential toxic PACs to evaluate risk to human health and the environment. An important concern regarding sites contaminated with PACs is the risk of groundwater contamination by release of the compounds from soils. The aim of this study was to investigate the occurrence of 77 PACs including PAHs, alkyl-PAHs, oxy-PAHs and NSO–PAFs among total aryl hydrocarbon receptor (AhR)-agonists in soils from historical contaminated sites and to assess the availability of the compounds in the soils. A novel approach combining chemical (GC/MS) and biochemical measurements (H4IIE-luc) combined with characterization of availability by use of a column leaching test and passive sampling was used. This approach allowed screening of potentially toxic metabolites of PACs in soils during remediation. The results show that chemical analysis of 16 US EPA PAHs to determine the degree of contamination of PACs in soils greatly overlooks toxicologically relevant PACs. Agonists in contaminated sites were clearly less toxic than the tested PAHs. Bioavailability of PACs in soils indicates low availability of the compounds in soils. The leachable fraction was generally greater for more hydrophobic PACs, such as more polar PACs composed of two or three rings. Contribution of the analyzed PACs to the overall AhR-mediated activities detected in soils, leachates and passive samplers was pretty small and confirms presence of several other AhR agonists in soils. Only a small fraction of AhR agonists were available in soils, indicating an overestimation of the risk, if only total initial concentrations in soils would be considered in risk assessment. However, the results show that analysis of available fractions based on only 16 US EPA PAHs have the potential to underestimate the risk of the soils.

MO434 Verification of read-across for aquatic hazard properties of Petroleum Substances in REACH registrations Y. Verhaeghen, CONCAWE; C. Hughes, Shell Health / Risk Science Team; L. Catherall, ExxonMobil Chemical and (A.D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; M. Comber, Mike Comber Consulting; S.A. Villalobos, BP / Global Product Stewardship; V. Ochoa, Cepsa; S. Linington, BP; E. Vaiopoulou, European Petroleum Europe Petroleum Substances are examples for UVCBs (substances of Unknown or Very limited data). Complex mixtures of biocides or bitumen PAHs and NSO–PACs. The chemical composition will vary depending on, among other things, the source of crude oil, the refinery processing and climate conditions. These substances present additional challenges when conducting environmental hazard and risk assessments under regulatory schemes such as REACH, and Concawe has developed bespoke models for these purposes. However, for purposes of hazard classification and labelling there is still a need for experimental aquatic toxicity test data on petroleum substances. Concawe substances have been organised into categories, based on similarities in refinery processes and physicochemical properties, resulting in a clustering of comparable chemical compositions and related hazard profiles. Applying read-across within a category is an established concept to fill in data gaps and to reduce unnecessary testing, and has been applied to available aquatic toxicity data for Concawe substances using a worst-case approach. ECHA recently released its Read-Across Assessment Framework (RAAF) for environmental endpoints, however the RAAF for UVCBs is still under development due to their added complexity. One recommendation of the RAAF when applying a category approach is to present data in a matrix to demonstrate that properties are similar or follow a regular pattern. In this presentation a category data matrix will be presented for the Concawe category of vacuum hydrocracked gas oils (VHGO). Available historical experimental aquatic toxicity data will be presented alongside substance identity information, predicted EL50 and toxic unit (TU) values calculated using PETROTOX, and results from biomimetic extraction solid phase microextraction (SPME) screening studies. The latter is a technique which measures bioavailable hydrocarbons, and has been demonstrated to correlate well with experimental and predicted aquatic toxicity data. The resulting, complimentary dataset forms a weight of evidence upon which to justify category approaches to the read-across of experimental toxicity data.

MO435 Automated Solid Phase Microextraction (SPME) for measuring freely dissolved concentrations of hydrophobic chemicals in soils, sediments and other solid matrices C. Vitale, University of Insurbia; K. Knudsmark Sjøholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; A. Di Guardo, University of Insurbia / Department of Science and High Technology; P. Mayer, Technical University of Denmark / Department of Environmental Engineering In risk assessment of hydrophobic chemicals that are strongly associated to the soil/sediment organic matter, freely dissolved concentrations (CMfree) are more representative than total concentrations (Ctotal) of their actual bioavailability, potential for bioaccumulation and toxicity. Such freely dissolved concentrations can be measured by Solid Phase Microextraction (SPME) if operated in the equilibrium and negligible depletion mode. Furthermore, in order to reduce the measurement variability, increase sample throughput and to produce high quality data, automated SPME methods are promising. The aim of this study was thus to investigate (1) how to operate automated SPME on solid samples, (2) how to achieve equilibrium sampling for hydrophobic organics within a practical time span and (3) how to calibrate the new approach. Polychlorinated biphenyls (PCBs) served as model compounds and matrices included soil, sediment and sludge.

MO436 New approaches for determining solubility of volatile liquid chemicals H. Birch, DTU Environment / Department of Environmental Engineering; L. Troelsen, Technical University of Denmark / Environmental Engineering; P. Mayer, Technical University of Denmark / Department of Environmental Engineering Water solubility is a fundamental parameter in environmental risk assessment of chemicals, and is theoretically a simple parameter to determine. For hydrophobic chemicals in the liquid state, the main challenge is to establish equilibrium between the pure liquid phase and the water phase within a reasonable time frame, while dropping from solution and negligible depletion mode. A slow–slow method for solubility measurements has previously been developed for this purpose, however it is time consumings as it requires weeks to equilibrate. In this work, two new approaches were used for solubility determinations. Both methods were originally developed for toxicity testing at the saturation level. Both approaches avoid direct contact between the pure substance and the water, thus minimizing the risk of droplet formation. The first approach uses passive dosing from a saturated silicone polymer in order to saturate the water, while the second approach equilibrates the water with the pure phase liquid through the headspace. Equilibrium time in the range of minutes to hours is expected for the two methods. Four liquid hydrophobic
chemicals within the logKow range of 4.4-8.6 will be included in the study, and results from both methods will be compared.

MO437 Headspace passive dosing for dose-response testing of volatile hydrophobic organic chemicals
L.N. Ting, Technical University of Denmark / Environmental Engineering; S.N. Søndergaard, Technical University of Denmark / Department of Environmental Engineering; M. Holmstrup, Aarhus University / Department of Bioscience; P. Mayer, Technical University of Denmark / Department of Environmental Engineering

Constant and well-defined exposure is crucial for the toxicity testing of liquid organic chemicals with high Henry’s constants, which are prone to substantial evaporative losses. A simple and effective headspace passive dosing method was developed and then applied to control the exposure of the freshwater algae Raphidocelis subcapitata and the terrestrial springtail Folsomia candida to terpenes and alcanes in toxicity experiments. The headspace passive dosing method applies a liquid partitioning donor placed in the headspace of the closed test vial for controlling exposure while avoiding direct contact and introduction of pure phase micro-droplets. Passive dosing from the pure liquid compound was applied for toxicity testing exactly at the solubility limit, and a dilution series of test chemicals prepared in purified vegetable oil served as donor for dose-response testing. The terpenes S-(-)-Limonene and a(+)-Pinene were tested in both the algal growth inhibition test and the springtail test. In addition, n-nonane, n-undecane and n-dodecane were tested on the algae, while iso-octane, iso-dodecane and n-dodecane were tested on the springtails. Our first results demonstrated that (1) the headspace passive dosing method is a simple yet effective way to control exposure to volatile hydrophobic organic chemicals and (2) that the method is straightforward to apply in algal growth inhibition and springtail toxicity tests. Further analyses of exposure parameters are in progress to better understand and quantify the resulting toxicity.

MO438 Application of biomimetic solid phase microextraction to characterize aquatic hazard of petroleum substances
L. Camenzuli, ExxonMobil Petroleum and Chemical; A.D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; D. Letinski, ExxonMobil Biomedical Sciences Inc; E. Vaiopoulou, European Petroleum Refiners Association

Environmental hazards of petroleum substances differ in response to variable substance composition. In response CONCAWE has initiated a comprehensive analytical program to extend analytical characterization of petroleum substances to further support hazard classification within and across petroleum substance categories. As part of this work, SPME and toxicity data for newly characterized substances (n=139), across approximately 10 major categories, were compared to historical data. New compositional data were used as input to PETROTOX to predict hazard endpoints. In this study, the freely dissolved concentrations (Cf) of the chemicals were determined using equilibrium with thin coatings of silicone on the inner walls of glass jars with subsequent solvent extraction. Total sediment concentrations (Ctot) were determined using accelerated solvent extraction. While there is a wide range of pollutants that have been detected in sediments worldwide, traditional chemical analysis cannot cover all compounds and their transformation products. Therefore, in this study, the extracts were dosed into seven cell-based bioassays covering cytotoxicity, activation of metabolic enzymes (binding to the arylhydrocarbon receptor, AhR), specific, receptor-mediated effects such as estrogenicity (ERa); and adaptive stress response (oxidative stress, AREc32). Cytotoxicity was assessed in all bioassays and occurred occasionally. Moreover, four of the seven bioassays were positive for AREc32, the peroxisome proliferation receptor gamma (PPARg) and ERa. The activation of the AhR was by far most responsive and showed a distinct pattern across the sampling locations. The other three assays showed responses only at higher enrichment factors of the extracts, also revealing specific contamination patterns. A comparison between Ctot vs. Cf will enable assessing the actual risk (Cf) vs. the potential hazard of those chemicals that might be released in future scenarios (Cf). The present work calls for more detailed studies at specific sites and testing of additional endpoints with the aim of obtaining a complete picture of mixture effects caused by the freely dissolved and total concentrations of hydrophobic organic chemicals in sediments.

MO441 Bioaccumulation of hydrophobic organic compounds in aquatic biota: addressing current challenges for in tissue passive equilibrium sampling
E. Rojo-Nieto, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; J. Koschorreck, Umweltbundesamt; m. zuB, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology Organisms living in environments contaminated with Hydrophobic Organic Compounds (HOCs) can enrich these chemicals, a process known as bioaccumulation. Current bioaccumulation assessment, based on exhaustive extraction of HOCs followed by lipid-normalisation, cannot distinguish between cases when bioaccumulation is driven by bioconcentration (passive uptake) or by biooxidation (uptake as food). This shortcoming obstructs reliable understanding of HOCs transfer in aquatic food webs, across trophic levels and between environmental compartments (sediment, water, biota). The recently proposed approach based on using ratios in chemical activity as a metric for bioaccumulation assessment represents a major advance relative to the traditional ones, since it aims at expressing the data on a common basis to enable direct comparison among compartments. Passive Sampling Devices (PSDs) are appropriate sampling tools for this purpose. We recently developed a geometrically designed PVD with a thin metallic window for measuring chemical activity. PSDs have been explored to compare contamination of sediments and biota with high lipid content and offer great potential to assess contaminant transfer in aquatic food webs. The presented work is one subproject of the ERC-funded project “CHEMO-RISK” which aims, amongst others, to address the bioaccumulation of HOCs in aquatic biota on a thermodynamic basis. We will develop silicone-based PSDs in order to broaden the use of these devices to those media that are equilibrating slowly, as is the case in lean tissues. For this purpose, homogenated fish tissues from the German Environmental Specimen Bank, with different lipid contents (ranging from 1 to 5%...
lipid), have been selected to optimise silicone-based PSDs for sampling in lean tissues. For this study, silicone is used as common reference phase, with sampler relocations across the homogenated samples along the sampling period, as has been proposed by Rusina et al. [1], in order to avoid the local depletion of the sample in direct contact with the silicone, and both, kinetic and equilibriun approaches have been considered. The 7 indicator PCBs (28, 52, 101, 118, 138, 153, 180) have been selected as target compounds, covering a wide range of Kow from 5.66 to 7.15. Reference:[1] Rusina TP, Carlsson P, Vrana B, Smedes F. 2017. Equilibrium passive sampling of POP in lipid-rich and lean fish tissue: Quality control using performance reference compounds. Environ. Sci. Technol., DOI: 10.1021/acs.est.7b03113.

MO442 Widespread occurrence of 4-Nonylphenol, BHT, and 2,4-DTBP in blue crab, Callinectes sapidus, madagapae in the northern Gulf of Mexico S. Chiasson, Loyola University / EEB; E.K. Grey, Governors State University / Division of science, mathematics, and technology; D.A. Grimm, Tulane University / Coordinated Instrumentation Facility; C.M. Taylor, Tulane University / Ecology & Evolutionary Biology The blue crab, Callinectes sapidus, is an ecologically and economically important invertebrate species in the northern Gulf of Mexico (NGOM). The NGOM receives nearly 60% of drainage from the river systems in the continental United States. Blue crab megalopae collected over three years from multiple estuaries in the NGOM from Texas to Florida were tested for alkylphenol contamination using GC/MS. We found evidence of alkylphenol contamination in blue crab megalopae monitored with 4-nonylphenol (NP), butylated hydroxytoluene (BHT), and 2,4-di-tert-butyphenol (DTBP). NP is an alkylphenol known to impair endocrine function and concentrations detected in megalopa in 2010 and 2011 exceeded the lower limit of the No Observed Effect Concentration range for aquatic invertebrates set by the US. Environmental Protection Agency. BHT is a commonly used food, pharmaceutical, and cosmetic ingredient and is considered a marine pollutant with low toxicity. All these compounds have high partition coefficients, which explains their presence in animal tissue. Concentrations of NP, BHT, and DTBP were highly correlated in megalopae over time at most study sites, implying a common source. The relatively high NP concentrations detected in juvenile blue crabs across the NGOM suggests that management strategies of alkylphenols in the environment should be re-evaluated to mitigate potential sub-lethal effects of exposure to blue crab populations.

MO443 Real-time visualization and quantification of perylene bioaccumulation at single cell level S. xu, School of Environment, Beijing Normal University; X. Jin, Beijing Normal University; F. Bai, Peking University Hydrophobic organic chemicals (HOCs) are of special ecotoxicological concern because they can be directly incorporated and bio-concentrated in living organisms. However, the effects of self-clustering of HOCs on their environmental behavior and toxicity is considered a significant challenge. A recent study has shown that perylene (P) can have an efflux pathway for parasitized chubs. The NGOM receives nearly 60% of drainage from the river systems in the continental United States. Blue crab megalopae collected over three years from multiple estuaries in the NGOM from Texas to Florida were tested for alkylphenol contamination using GC/MS. We found evidence of alkylphenol contamination in blue crab megalopae monitored with 4-nonylphenol (NP), butylated hydroxytoluene (BHT), and 2,4-di-tert-butyphenol (DTBP). NP is an alkylphenol known to impair endocrine function and concentrations detected in megalopa in 2010 and 2011 exceeded the lower limit of the No Observed Effect Concentration range for aquatic invertebrates set by the US. Environmental Protection Agency. BHT is a commonly used food, pharmaceutical, and cosmetic ingredient and is considered a marine pollutant with low toxicity. All these compounds have high partition coefficients, which explains their presence in animal tissue. Concentrations of NP, BHT, and DTBP were highly correlated in megalopae over time at most study sites, implying a common source. The relatively high NP concentrations detected in juvenile blue crabs across the NGOM suggests that management strategies of alkylphenols in the environment should be re-evaluated to mitigate potential sub-lethal effects of exposure to blue crab populations.

MO444 Impregnation factors of freshwater fish by organic micropollutants in the Marne Hydrographic network N.F. Molbert, UPMC UMR METIS 7619 / Biogeochemistry; M. Chevreuil, EPHE / UMR METIS 7619; F. Alliot, EPHE / UMR Metis; R. Santos, HEPIA; J. Mouchel, UPMC UMR METIS CNRSUPMC; A. Goute, EPHE / UMR METIS Ecotoxicology faces the challenge of monitoring the levels of an increasing number of chemicals on biota. While persistent pollutants have been largely studied, several pollutants are metabolized, especially by vertebrates. Despite the higher toxic potential of metabolites compared to their parent compounds, little attention has been given to metabolites. Several persistent micropollutant families (Polychlorinated Biphenyls (PCB), Organochlorine Pesticides (OCP)) and metabolizable ones (Polycyclic Aromatic Hydrocarbons (PAH), phthalates, pyrethroid pesticides), as well as their metabolites were measured in a free-living freshwater fish, the European chub (Squalius cephalus, N = 113) caught by electrofishing operations in the Seine watersheds. The occurrence of pollutants were characterized in muscles and their metabolites in bile and liver using gas chromatography (GC-MS / MS) and high performance liquid chromatography (HPLC-MS / MS) coupled to a mass spectrometer. Body burdens of pollutants in chubs were then explained according to the environmental (surface water and sediments) contamination and individual parameters (age, body length, health status and parasitic load). Despite restrictive legislation, persistent pollutants (OCP, PCB) were found in all environmental matrices and fish tissues. Pheralates were the most abundant chemicals, with concentrations in fish muscles in the range 41±6-2200 ng g⁻¹. Positive correlations were detected between the environmental pollution and the levels of persistent pollutants (PCB, OCP) in chubs, but not for the metabolizable chemicals, likely due to their rapid degradation and excretion. No correlation was found between micropollutant levels and health status of chubs, suggesting low ecotoxicological effects of these contaminants exposure in the Marme hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pomphorhynchus laevis were less contaminated. In the study sediments and water from the North and Baltic Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as following: First, the samples were homogenized with sodium sulphate. Afterwards, extraction and clean-up was performed using an accelerated solvent extraction (ASE-350, DIONEX, Germany) method. For this, 22 mL stainless steel ASE cells were filled with 100 ml deactivated silica and approximately 5 g sediment that was spiked with appropriately isotope labelled standards. The cells were extracted using dichloromethane for three 10 min-cycles at 100 °C. The extracts were solvent-changed to methanol and reduced to volume in 150 µL. The instrumental analysis was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadrupole LC/MS, Agilent Technologies, Germany) equipped with an APPI-source and a C18 column (Eclipse Plus RRHD 1.8 µm, 2.1 x 150 mm, Agilent Technologies, Germany). Total Organic Carbon (TOC) analysis was carried out with aliquots of the freeze-dried samples using a LECO RC612 multiphase (Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the North and Baltic Seas for the first time. Several substances have been identified in concentrations in the low ng/g dw range.

MO446 Is Lake Como a "uniform lake"? Information from its inhabitants (zooplankton and fish) M. Bonomi, University of Insubria (Como) / DiSTAB; A. Buffo, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; R. Penna, University of Insubria; S. Polesello, Water Research Institute- CNR / Water Research Institute; S. Valsecchi, Water Research Institute - Italian National Research Council IRSA-CNR; R. Bettinetti, University of Insubria / DiSTABA Lake Como, a subalpine lake (Northern Italy), is an oligomictic lake, with complete water mixing occurring after particularly windy and cold winters. It presents a typical shape of an upside “Y” where a western, eastern and northern basin can be identified. In more detail, the western branch is distinctly separated from the rest of the lake by an underwater ridge, where the highest depth is measured (425 m at
Argegno), and does not present an outlet, resulting in a longer real water renewal time. On the other side, waters of the eastern branch are encouraged to flow towards south directly through the Adda River, which is also the main inlet in the northern branch. Western and eastern branches also present different level of trophic status. In the present work, we investigate if these main morphological features can lead to differences a) in zooplankton density and biomass, b) in the interactions between zooplankton and phytoplankton, and c) in levels of pollution between the pelagic areas of the two branches, evaluated along a seasonal sequence. Preliminary data tell that the taxon composition of the pelagic planktonic communities is the same in the basins but differences in density and biomass are highlighted. These differences are found in levels of contamination of legacy compounds (DDT, PCB) while there are not differences between the two branches in concentrations of perfluoralkyl substances (PFAS).

MO448 Kinetic Sorption and Bioaccumulation of Hydrophobic Organic Chemicals in Marine Plankton Food Chain

Bioaccumulation and distribution of polycyclic aromatic hydrocarbons (PAHs) over different amounts of exposure time were investigated in the plankton food chain including phytoplankton and zooplankton. The simulated plankton food chain was using phytoplankton (Tetraselmis chuii), rotifers (Brachionus sp.), and copepas (Acartes minutus) cultured in a gas purging system with a steady supply of PAHs for 7 days in this study. The results show that PAH accumulation in plankton can be roughly divided into three sections: 0.2-1 hours, 1-24 hours, and 24-168 hours. The PAH concentrations in plankton varied greatly over the 0.2-1 and 1-24 hour time intervals, then approached study-state at 24-168 hours exposure. The low molecular weight PAHs (ACN, AC) were found at significantly higher levels compared to that of higher molecular weight PAHs (FA and PY) were found at significantly higher levels in phytoplankton, indicating that plankton might have selectivity towards PAHs. In principal component analysis (PCA), the plankton could be separated significantly into phytoplankton and zooplankton. Parts of the PAH accumulation found in rotifers and copepods were similar, demonstrating that PAH composition in plankton might be affected by trophic levels. All PAHs demonstrated significantly linear relationships between bioconcentration factor (BCF) and PAH hydrophobicity (Kow) in plankton, however the linear regression slopes of log BCF and log Kow were different, suggesting that the plankton have different pathways of PAH accumulation.

MO449 Do weathered multiwalled carbon nanotubes influence the distribution of the biocide triclocarban in a sediment-water system?
L. Benne, I. Polkowski, M.P. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics.

Multiwalled carbon nanotubes (MWCNT) are widely used nanomaterials in a variety of different products and processes, well-known for their high sorption capacity. Due to increasing usage and production, exposure to the aquatic environment either accidentally or via disposal of CNT-containing products might increase likewise. Weathering processes like radiation can alter nanoparticle properties and lead to significant changes in their environmental behavior and persistence. Weathering of a MWCNT in the water phase is very short; due to agglomeration and aggregation processes they preferably settle down in sediments, which represent a potential sink for carbon-based nanomaterials. Nevertheless, during their stopover in the water phase they may interact with water dissolved xenobiotics, and thus alter nanoparticle characteristics. Identification of robust links between concentrations of hydrophobic compounds in environmental compartments (mainly in sediment) and concentrations in biota. Our study encompasses 22 field locations at which we are monitoring the concentrations of a set of hydrophobic organic compounds and total Hg in both sediment and biota (fish and mussels). In addition, some sediment characteristics, i.e. organic carbon content (TOC) and clay content are measured and water and sediment characteristics are monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being constructed to establish the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.

MO450 When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule
B. Journel, E. Beltran, CEHTRA SAS; P. Adrian, CEHTRA.

Face of substances in the environment are driven by numerous factors. Among them, substance’s properties such as Henry’s constant (i.e. water solubility and volatility) and hydrophobicity (in terms of Kow and adsorption) have a non-negligible impact on how substance’s behaviour is modelled in the different compartments (soil, water, sediment, air), to predict exposure levels in risk assessments. Pharmaceuticals represent a specific category of substances as they are difficult to analyze and cleaning up experimental results more subject to imprecision. Due to analytical difficulties, parameters such as water solubility and Kow, are often expressed as “lower than” or “higher than” and have no defined value. Additionally, model softwares such as EUSES impose maximum value for Kow and minimum value for water solubility as input parameters, whereas EU TGD spreadsheet allows to consider the experimental results. The decision on the parameter values and models to be considered needs then expert judgement. We will present the case of a pharmaceutical molecule currently studied, for which water solubility and then Kow, cannot be precisely measured experimentally. While staying regulatory compliant and reflecting the experimental results, the input values chosen for these parameters have a significant impact on calculated PECs for this insoluble molecule. Studies on fate and behaviour in soil and water/sediment systems are to be conducted, however considering the technical difficulties to analyse the molecule, and the route of environmental exposure, it may be necessary to define a category of molecules for which some of current regulatory requirements could be waived related to their chemical properties. A proposal for an appropriate risk assessment will be provided.

MO451 Effect of environmental characteristics on the bioavailability of hydrophobic organic compounds to fresh water organisms from natural aquatic systems
L. Teunen, University of Antwerp; C. Belpaire, Research Institute for Nature and Forest INBO; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Many aquatic ecosystems are under persistent stress due to influxes of anthropogenic chemical pollutants. High concentrations can harm entire ecosystems and be potentially toxic to humans. The European Water Framework Directive (WFD) obliges member states to monitor chemical compounds in surface waters and to set quality standards that are protective for the ecological integrity. Generally, most of the target chemical compounds are measured in water samples or in environmental samples. However, in the case of highly hydrophobic compounds, their very low water solubility precludes direct measurement in water, and thus alternative monitoring strategies are needed. Accordingly, the WFD has formulated biota quality standards (BQS) which refer to concentrations of compounds that have to be monitored in fish and invertebrates. In the present study we are investigating the reliability and relevance of BQS by studying the relationships between concentrations of hydrophobic compounds in environmental compartments (mainly in sediment) and concentrations in biota. Our study encompasses 22 field locations at which we are monitoring the concentrations of a set of hydrophobic organic compounds and total Hg in both sediment and biota (fish and mussels). In addition, some sediment characteristics, i.e. organic carbon content (TOC) and clay content are measured and water and sediment characteristics are monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being constructed to establish the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.

MO452 Personal care products (PCPs) in the southeastern coast of Brazil: Identification of the method and environmental occurrence
T. Combì, Instituto Oceanográfico da Universidade de São Paulo / Instituto Oceanográfico; R.C. Montone, Universidade de Sao Paulo / Oceanographic Institute

The use of large amounts and a broad variety of chemicals that are potentially harmful to the environment (including persistent organic pollutants (POPs), personal care products (PCPs) and biocides) in the marine environment could be problematic for biota and sediments. The existence of such a high number of compounds in the environment leads to interferences during chemical analysis, hindering the assessment of the occurrence and distribution of contaminants in environmental matrices. Thus, the development and optimization of analytical methods that can detect multiple classes of compounds at very low levels and the contamination assessment in marine and coastal areas are among the most complex and current issues in environmental chemistry. Possible adverse effects related to some groups of PCPs, such as potential to accumulate through the trophic food chain and in human adipose tissues, endocrine disruption and hazard to coral reef conservation
have been recently detected. Consequently, their study has become a priority among the main bodies responsible for protecting public health and the environment, such as the European Commission and USEPA. However, the current knowledge about the occurrence and fate of PCPs is still scarce, especially in less developed or developing countries as Brazil. Thus, this study aims to evaluate the occurrence of PCPs in surface sediments of selected areas along the southern and southeastern Brazilian coast through the optimization and implementation of a state of the art methodology. Preliminary results obtained from surface sediment samples from São Paulo coastal areas through micro-wassisted extraction (MAE) and triple-quadrupole mass spectrometer analyzes (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EHMCl) and fragrances (tonalide and galaxolide). The next steps of this work include testing additional extraction methodologies, extraction solvents and clean-up procedures to improve the detection and quantification of these compounds. The final results of this work will provide the first extensive dataset on the occurrence, levels and fate of PCPs in the Southern Atlantic which will not only contribute with new and rather scarce data but also with valuable information for regional and global inventories.

**MO453** IFRA Environmental Standards and RIFM Safety Assessment Program Advances Update for 2018
A. Łapczynski, RIFM / Environmental Science; D.T. Salvito, Research Institute for Fragrance Materials (RIFM) / Dept of Environmental Science; C. Gonzalez, IFRA
To assure safety of fragrance ingredients in consumer products, International Fragrance Association (IFRA) and RIFM have developed the fragrance industry’s self-regulatory safety program with the development of IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessments for these Standards are incorporated in the Research Institute for Fragrance Materials’ (RIFM) testing program in coordination with its Expert Panel. To identify materials for risk assessment refinement, fragrance materials were screened using the RIFM Environmental Framework and 2008 IFRA volume of use survey as reported for both Europe and North America. The Framework for this evaluation was published in Environment Toxicology and Chemistry (Salvito et al., 2002, 1301-1308). In addition, hazard assessment on these materials was also performed and reviewed. As a result nearly 3,000 materials were screened with preliminary risk quotients estimated to rank materials for risk assessment refinement in an effort to provide greater transparency to the IFRA Environmental Standards, RIFM reports the most recent results of these additional tests (for both risk and hazard assessments) at both the annual SETAC NA and Europe meetings. These studies include persistence testing (ready biodegradation tests and die-away studies), bioaccumulation, and acute and chronic aquatic toxicity. Incorporating these new data in a second tier risk and hazard assessment for these materials will also be presented.

**MO454** Comparison of different sampling techniques for the identification fire effluents from low-density polyethylene burning
A. Al-Bahah, King Fahd Security College / Forensic Science Department; A. A. Stec, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing; Y. Badjah-Hadj-Ahmed, King Saud University / College of Science, Chemistry Department; R. Hull, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing. Huge amounts of various polymers are being used in many fields with numerous benefits. However, their great ability to ignition and rapid flame spreading make these materials dangerous for human life and properties due to the release of highly toxic combustion products. The present work aims to investigate several methods of sampling and analysis of polycyclic aromatic hydrocarbons (PAHs) produced by controlled burning of low-density polyethylene (LDPE) using a toxicity tube furnace. Five different sampling methods were used: solid phase micro extraction (SPME), syringe, tedlar bags, sorption tubes, and gas-solution absorbers. The produced hydrocarbons were analysed by gas chromatography coupled to mass spectrometry with and without pyrolysis. The analysis of PAHs released from polyethylene combustion showed that emissions with a potentially negative impact on the human health and the environment are produced in significant concentrations. Among the tested techniques, the most convenient sampling method was that using syringe with a glass vessel which allowed detection of the highest amount of PAHs at both 800 and 600°C, then followed by SPME. On the other hand, the use of gas-solution absorber (midget impinger) showed poorer results. Regarding the use of tedlar bags and sorption tubes, they did not give satisfactory results. Several carcinogenic or possibly carcinogenic compounds were identified in the combustion products, such as benzene, naphthalene, anthracene and pyrene.

**MO455** PbTk modelling of super-hydrophobic chemicals
W. Lariitch, K. Goss, Helmholtz centre for environmental research - UFZ / Analytical Environmental Chemistry
It is a widespread opinion that super-hydrophobic chemicals are not taken up by fish [1–3]. But so far, we haven’t seen sufficient evidence why they should not cross membranes or aqueous boundary layers, although these processes might be kinetically slow. Super-hydrophobic chemicals are very challenging for controlled exposure experiments. Here we use the few existing data points of a fish feeding study with Declorane (log Kow (estimated) = 11.6) with our recently published PbTk model, TK-fish, to shed more light on this issue. We first validated the oral uptake pathway in our model and found that facilitated transport via albumin and bile mielles through the aqueous boundary layers must accounted for, for super-hydrophobic chemicals such as HCB in order to get correct results. Subsequent simulations with the super-hydrophobic chemical Declorane revealed that for an oral uptake route the diffusive transport through aqueous boundary layers in the gastro-intestinal tract and in the blood is indeed the limiting process. Good agreement of the predicted model results with measured values indicates that there is no principal hindrance for the oral up-take of super-hydrophobic chemicals. The results also indicate that it would take roughly 2 years or more for a steady state to be established which is too long for an experimental exposure study. 1. Dyer SD, Bernhard MJ, Cowan-Ellisberry C, Perdu-Durand E, Demmerle S, Cravedi J-P. 2008. In vitro biotransformation of surfactants in fish. Part I: linear alkylbenzene sulfonate (C12-LAS) and alcohol ethoxylate (C13EO8). Chemosphere. 72:850—862. 2. Sakurutani Y, Noguchi Y, Kobayashi K, Yamada J, Nishihara T. 2008. Molecular size as a limiting characteristic for bioconcentration in fish. J. Environ. Biol. 29:89—92. 3. 2016. Guidance on Information Requirements and Chemical Safety Assessment, Chapter R.11: PBT/vPvB assessment Draft Version 3.0,European Chemicals Agency, Helsinki. https://echa.europa.eu/documents/10162/23047722/ef_csa_r11_pbt_peg_en.pdf/ddacf03d4aa4-9f9e-3efc-738162baae48

**Migratory bird species at risk - the role of pesticides and other chemicals (P)**

**MO456** Main scientific gaps in knowledge of risk from pesticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
C.A. Bishop, Environment and Climate Change Canada / Wildlife Research Division

**MO457** Main scientific gaps in knowledge of risk from rodenticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
P. Berny, VETAGRO-SUP / Toxicology

**MO458** Main scientific gaps in knowledge of risk from Pb ammunition and shot to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
R. Cronic, Wildfowl & Wetlands Trust

**MO459** Main scientific gaps on knowledge of NSAIDs [migratory] wildlife globally, and potential contribution of WTIG to CMS questions
M. Taggart, University of the Highlands and Islands / Environmental Research Institute

**MO460** Main scientific gaps on knowledge of deliberate poisoning to [migratory] wildlife globally
M. Odlin, Independent Environmental Services Professional

**Big data analysis in ecotoxicology: how to get new information out of existing data? (P)**

**TU001** Holistic evaluation of long-term field effect earthworm studies with the fungicide Boscalid
F. Staab, BASF SE; J. Roemhke, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kabouw, BASF France S.A.S.
In order to place a plant protection product on the market, the product and its active substances need to demonstrate an acceptable risk to earthworm communities. The current European risk assessment scheme follows a tiered approach using worst case environmental concentrations and endpoints from earthworm reproduction laboratory studies in tier 1. For the active ingredient Boscalid no risk to earthworms has been identified based on the chronic laboratory studies provided by BASF to EU registration authorities. However, for one of the formulated products containing Boscalid the tier 1 assessment did not allow to exclude a potential...
long-term risk to earthworms in the field. Therefore, a comprehensive field study program was conducted in different crops and field sites in Germany between 2000 and 2010. The study program went beyond regulatory requirements and comprised 6 independent long-term field studies that ran up to five years and were accompanied by a comprehensive residue analysis program. The number of earthworm field data generated is - to our knowledge - one of the highest ever collected for one plant protection product. We evaluated the extensive data set using the "ecological" and "chemical" endpoints putting representativeness/comparability of the data to the field conditions in focus. This showed that the results of the replicated earthworm field experiments were comparable between each other and that the highest earthworm population densities were measured in the solvent control treatments of the field studies.

ECOTOX Knowledgebase: New tools for data visualization and database interoperability
C. Elonen, U.S. EPA/ORD/NHEERL; J. Olker, C. LaLone, U.S. EPA / Mid Continent Ecology Division; D.J. Hoff, U.S. EPA ORD / Mid Continent Ecology Division; S. Erickson, M. Skopinski, S. Casey, A. Pilli, K.A. Fay, CSRA, Inc. The ECOTOX Knowledgebase (ECOTOX) is a comprehensive, curated database which allows access to single chemical exposure studies from terrestrial and aquatic organisms. The ECOTOX Knowledgebase provides risk assessors and researchers consistent information on toxic effects of chemicals for use in deriving benchmarks and establishing criteria. ECOTOX has the capability to refine and filter data searches by 16 parameters (e.g. Species, Chemical, Effect, Control, Year, etc.) and customize output selections from over 100,000 fields. Study details such as species taxonomy, hierarchy, chemical purity, routes of exposure, and all calculated or statistically derived endpoints provided by the authors is encoded in discrete data fields for each test result. During the past 10+ years, ECOTOX has aligned the codification of the aquatic and terrestrial references by the addition of data fields, adapted search terminology to better focus literature searches, and updated search screens. To meet the data needs of 21st century toxicological assessments, new tools have been integrated into ECOTOX to improve data mining capabilities for end users such that environmental regulatory, the regulated industry, and researchers can more effectively and efficiently search and use existing toxic effects data. New data visualization and filtering options have been added to aid in data exploration. Efforts to enhance interoperability with other EPA databases have been employed to assist in efficiently accessing necessary data. The improved tools will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.

TU005 Edaphostat - A web application for automated and interactive meta-analysis of environmental data from the Edaphobase database
J. Hausen, RWTH Aachen University; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research

A steadily increasing number of databases in ecotoxicology and ecology combine not only toxic data from different studies and research programs. Usage of these databases promises new insights in species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automatic analysis tools, which are customized for certain data warehouse applications, can be a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase database [1]. The Edaphobase performs several steps of data cleaning, formatting, and transformation to make datasets comparable. Preprocessed data are analyzed and the results are visualized as interactive plots and dashboards. The tool depicts species distribution alongside environmental gradients (for example pH and C/N) and habitat parameters (such as soil classes) and species settlement in ecological niches. Edaphostat makes use of the results of the Edaphofootprint [2], a multimedia fate model for soil data selected by e.g. area, time period or study design. It performs automated analysis of environmental data to assess species-specific aetiological preferences and ecological niches.

TU006 Deriving USEtox aquatic freshwater toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program
E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; A. Gissi, European Chemicals Agency; P. Karamertzianis, ECHA; B. Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research

The use of the results of the Edaphofootprint [2], a multimedia fate model for soil data selected by e.g. area, time period or study design. It performs automated analysis of environmental data to assess species-specific aetiological preferences and ecological niches.

TU004

Enhancing the utility of the ECOTOX knowledgebase via ontology-based semantics mapping

The US Environmental Protection Agency’s Ecological Toxicology (ECOTOX) knowledgebase contains more than 30 years of reported single chemical toxicity effects data on aquatic and terrestrial organisms. Approximately 900,000 test results covering more than 11,000 chemicals and 12,000 species are available in ECOTOX. While the database is currently used by many sectors for a variety of purposes, a future goal is to allow for computational modeling of the data to identify novel adverse outcome pathways and networks, and assist in predicting species toxicity data (41’381 substances for use in deriving benchmarks and establishing criteria. ECOTOX has the capability to refine and filter data searches by 16 parameters (e.g. Species, Chemical, Effect, Control, Year, etc.) and customize output selections from over 100,000 fields. Study details such as species taxonomy, hierarchy, chemical purity, routes of exposure, and all calculated or statistically derived endpoints provided by the authors is encoded in discrete data fields for each test result. During the past 10+ years, ECOTOX has aligned the codification of the aquatic and terrestrial references by the addition of data fields, adapted search terminology to better focus literature searches, and updated search screens. To meet the data needs of 21st century toxicological assessments, new tools have been integrated into ECOTOX to improve data mining capabilities for end users such that environmental regulatory, the regulated industry, and researchers can more effectively and efficiently search and use existing toxic effects data. New data visualization and filtering options have been added to aid in data exploration. Efforts to enhance interoperability with other EPA databases have been employed to assist in efficiently accessing necessary data. The improved tools will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.
and toxicity indicators for thousands of chemicals to be used in the USEtox model. The poster presents the methodology applied for the selection of the aquatic toxicity data available in REACH, the set of criteria used to derive various level of quality data to meet the requirement to produced Effect Factors for as many chemicals as possible, and the various calculation procedure to derive final chemical effect factors. Correlation between acute and chronic toxicity for thousands of tests, for each chemical, was graphically stabilised, as well as the feasibility to calculate effect values based on Species sensitivity distribution. The following final calculation have been performed for thousands of chemicals: - Acute and Chronic species geometric means with standard deviation and number of individual test available per species - Arithmetic average of all the log of the species geometric mean with standard deviation and count of species as well as count of SSD group for each chemical - Species geometric and Chronic geometric means with standard deviation - Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TU007 Deriving physico-chemical input data for the USEtox model from the REACH database for thousands of chemicals using R-Studio program
F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; S. Prenca, EU Commission Joint Research; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC/ Sustainable Assessment Unit
Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF) form a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). The potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model. This model requires for each single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life and terrestrial ecotoxicity to soil for cancer and non-cancer effects. For PEF/OEF, these data are required for thousands of chemicals using the most up-to-date information. The EU commission Joint Research Centre has obtained from the chemical agency (ECHA) for more than eight thousand chemicals data regarding physico-chemical properties (166 926 test results, as of March 2017) available in the IUCrLD 5.5 database. These data have been processed to automatically derive accurate values for six of the physico-chemical properties required by USEtox for fate modelling: Kow, Koc, vapour pressure, water solubility, Henry law constant and biodegradability; in addition, adsorption partition coefficient (Kd) to suspended matter, sediments and soil for inorganic compounds were determined. In order to provide high quality results, criteria were applied for selecting data on the basis of their reliability (assessed by Klimisch scores), purpose and study type. Moreover, other specific criteria were defined for each properties according to the method used, such as experimental condition (temperature and pH). Geometric mean and the coefficient of variation, for their reliability evaluation, of the consistent data selected was performed. A correlation analysis of the results with values previously included in USEtox and with values obtained with computational methods (Q3AR/QSPR) was established to assess the quality of this proposed automated approach. A quality levels approach is proposed. This, paired with the abovementioned statistical index, represents a helpful support to the user for evaluating the reliability of each parameter used in the fate model. For chemicals with no available data or not satisfying the minimum quality requirements, physico-chemical properties were derived using in-silico tools (Q3AR/QSPR). In particular, OECD QSAR toolbox and the EPIsuite estimation models played a fundamental role for this data gap filling purpose.

TU008 Toward a possible Toxicity Test Battery Integrated index for Nanomaterials
M. Olivieri, University Parthenope; s. schiavo, ENEA CR; s. manzo, ENEA / SSP-TROTTER-BES
Nanotechnology is a rapidly expanding field of research continuously producing novel materials with nanoscale properties (nanomaterials, NMs), as result, it is inevitable that NMs will enter the aquatic environment. Usually the ecotoxicological approach is generally based on a battery of bioassays with organisms belonging to toxicologically optimized, non-chronic trophic levels and the approach is repeated for each species. While these endpoints, taken individually, can indicate the presence of a potentially deleterious effect, it is often difficult to combine these effects into an assessment of the overall status for the selected environment. Therefore is necessary to integrate all results to evaluate the risk for NMs. To synthesize the results obtained with a battery of ecotoxicological tests, different approaches were developed such as Toxicity test battery integrated index (TBI). This index has the advantage to put in evidence the differences between the samples. However there are still some open issues and TBI integration procedure needed to be modified according to testing sample or substance in order to represent the test sensitivity towards the matrices. In particular, when NMs are investigated also different physico-chemical behaviour and interaction with organisms should be taken into account. Therefore, the aim of this work is to study the suitability of TIB procedure for the NM to determine the needed modification for tailoring the data integration. In particular, we considered metal bearing nanoparticles (NPs) such as TiO2, SiO2 and ZnO and a battery of toxicity test with organisms of different biological complexity and representative of different trophic levels with the aim to establish a unique toxicity ranking. From the analysis of the results integration with TBI it could be highlighted that to define the hazard associated with NPs is necessary to tailor the index parameters on specific NMs physico-chemical characterization. Moreover, to make the results more reliable, together with a larger number of tests, a longer testing time for some organisms and other endpoints (genotoxic and cytotoxic parameters) should be utilized.

TU009 Historical analysis of the use of plant protection products in apple orchards (1970-2014): Combining handwritten farmers records with electronic data
L. de Baan, Agroscope / Institute for Plant Production Sciences IPS; M. Mathis, J. Stroger, Agroscope; O. Daniel, Agroscope / Institute for Plant Production Sciences IPS
Plant protection products (PPPs) are used to protect crops against pests and diseases and ensure yields and quality of crops. Because they are biologically active, they can cause negative side effects on the environment or humans. Data-sets on the use of PPP for specific crops over a long time would allow to get a better knowledge on the regional emissions of PPP with the beyond the agro-ecosystems. However, consistent long-term datasets are mostly lacking. In addition, historic farmers’ records are often only available in handwritten paper format. In Switzerland, data on PPP use in apple orchards has been voluntarily recorded by farmers since the 1950-ies, to evaluate farm economics. Up to the 1990-ies, data were only available in handwritten paper format, since 1997 they were collected electronically. In this study, we digitised the handwritten records and combined it with the digital data. We first developed a concept, how the handwritten records can be entered into a database, which contains similar information as the electronic data. We collected data on farms (productivity), apple plantations (year of plantation, size, type, variety), and plant protection measures per plantation (product, dosage, date of application). In We also developed procedures to handle missing data and to detect mistakes in the indicated dosage or field size. Finally, a dataset of spray sequences in apple orchards over the period 1970-2014 was analysed, regarding the number of treatments per PPP category (e.g. fungicides), the total amount of active ingredients applied per season and PPP category and the ranking of chemical groups per PPP category. While the average number of treatments and the average amount of active ingredients remained within a similar range, major changes were detected in the composition of applied active ingredients. For example, in the 1970-ies and 80-ies, more than 75% of all insecticide treatments were organophosphates. After 1986, organophosphates were quickly replaced by carbamates and benzoylureas, and today only contribute to about 10% of all insecticide treatments. This study illustrates, that for a historic analysis of pollutants it is sometimes unavoidable to fire regional handwrittens of PPP with the beyond the agro-ecosystems. However, this effort resulted in a unique 44 year time series of PPP use in apple orchards. In a next step, we will analyse the historic development of ecotoxicological risks of PPP usage in apple orchards.

TU010 Using long-term datasets to assess the impacts of neonicotinoids on farmland bird populations in the UK over the last 21 years
R. Lennon, The University of York / Environment; N. Isaac, NERC Centre for Ecology & Hydrology; R. Shore, Centre for Ecology & Hydrology (NERC); K. Arnold, University of York / Environment; W. Peach, Royal Society for the Protection of Birds; C. Brown, University of York / Environment Department. This study builds on the majority of research regarding neonicotinoids (NNs) has been focused on pollinator species, however, little work has been done to investigate the potential long-term impacts of these pesticides on other taxa, such as farmland birds. Birds can be directly exposed to NNs via two main exposure routes: ingestion of NN-coated grain, or seedlings germinated from coated grain. With bird abundance data, NN usage records and UK cropping data, a poisson log-linear generalised mixed model was used to investigate whether there are any impacts of NN use on farmland bird populations over a period of 21 years. Specifically, the main objectives of this study were to 1) establish whether there is a relationship between species population growth and NN usage in the UK, 2) establish whether species traits, such as body weight and home range are correlated with any effect of NNs on individual species population growth and NN usage in the UK, 3) establish whether there is a relationship between species population growth and NN usage on farmland bird populations and NN usage on farmland bird populations over a period of 21 years.

TU011 Regression-based models reveal sources of pollutants in Norwegian marine sediments
G. Everaert, Flanders Marine Institute / Laboratory of Environmental Toxicology and Aquatic Ecology; A. Ruus, NIVA / NIVA; D. Hjernman, NIVA Norwegian Institute for Water Research; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences; N.W. Green, NIVA Norwegian Institute for Water Research / marine pollution; S. Boitsov, Institute of Marine Research; H. Jensen, Geological Survey of Norway; A. Poste, Norwegian Institute for Water
Research

We characterized spatial patterns of surface sediment concentrations of seven polychlorinated biphenyls (PCBs), seven polycyclic aromatic hydrocarbons (PAHs), three chlorinated pesticides and five metals in Norwegian waters and Skagerrak. In total, we analysed 5,036 concentrations of 22 chemical substances that were measured between 1986 and 2014 at 333 sampling sites by means of generalized additive models (GAMs). We found that GAMs with organic carbon content of the sediment and latitude and longitude coordinates explained ca. 75% of the variability of the contaminant sediment concentrations. For metals, a predominantly hotspot-driven spatial pattern was found, i.e. we identified historical pollution hotspots (e.g. Sørøya in western Norway) for mercury, zinc, cadmium and lead. Highest concentrations of PAHs and PCBs were found close to densely populated and industrialized regions, i.e. in the North Sea and in the Kattegat area and Skagerrak. The spatial pattern of the PCBs suggests the secondary and diffuse atmospheric nature of their sources. Atmospheric inputs are the main sources of pollution for most organic chemicals considered, but north of the Arctic circle, we found that concentrations of PAHs increased from south to north most likely related to a combination of coal-eroding bedrock and the biological pump. The knowledge acquired in the present research is essential for developing effective remediation strategies that are consistent with international conventions on pollution control.

TU012

Application of a ‘weight-of-evidence’ model for assessing sediment quality and associated hazard with offshore gas platforms discharging produced water

A. Tonnesen, ISPRA/Naturparkmessstasjon, Skagerrak

Due to their persistence and global distribution the use of organochlorine pesticides (OCPs) as well as Hexachlorocyclohexane (HCHs) are still widely used in agriculture, forestry and for pest control. Consequently, the knowledge of OCPs and HCHs bioaccumulation in biofilms, with two different exposure concentrations and exposure periods, is essential for the evaluation of existing monitoring programs. Therefore, we used a photosynthesis inhibitor herbicide: diuron, one of the priority substances (PS) of the European Union and a known bioindicator for water quality assessment (Edwards and Kappes 2008). We characterized diuron bioaccumulation in biofilms, with two different exposure concentrations and exposure periods, on the surface of 48 biofilms. Here, the bioaccumulation was undertaken to determine the biological effect of the DDT exposure. In this poster we collated and integrated the exposure (DDT and HCH bioaccumulation) and effect (biomarker) data of the different studies to test the hypothesis that increased DDT exposure will elicit similar biological responses across species.

Site 1 was an offshore gas platform in a heterogeneous Arctic environment, housing several oil production structures and gas platforms. Site 2 was a similar offshore gas platform in a temperate environment. Site 3 was an offshore gas platform in the temperate environment with higher productivity. Site 4 was a temperate offshore gas platform with higher productivity. Site 5 was a temperate offshore gas platform with lower productivity. Site 6 was a temperate offshore gas platform with lower productivity and no gas production. Site 7 was an offshore gas platform in the temperate environment with higher productivity and no gas production. Site 8 was a temperate offshore gas platform with lower productivity and no gas production. Site 9 was an offshore gas platform in the temperate environment with higher productivity and no gas production. Site 10 was an offshore gas platform in the temperate environment with lower productivity and no gas production. 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Site 43 was an offshore gas platform in the temperate environment with lower productivity and no gas production. Site 44 was an offshore gas platform in the temperate environment with lower productivity and no gas production. Site 45 was an offshore gas platform in the temperate environment with lower productivity and no gas production. Site 46 was an offshore gas platform in the temperate environment with lower productivity and no gas production. Site 47 was an offshore gas platform in the temperate environment with lower productivity and no gas production. Site 48 was an offshore gas platform in the temperate environment with lower productivity and no gas production.

We found that concentrations of PAHs increased from south to north most likely related to a combination of coal-eroding bedrock and the biological pump. The knowledge acquired in the present research is essential for developing effective remediation strategies that are consistent with international conventions on pollution control.

Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring (P)

M. Simonin, Duke University / Biology; K.A. Voss, Regius University; B.A. Hassett, J.D. Rocca, S. Wang, Duke University / Biology department; C.R. Violin, University of North Carolina at Chapel Hill / Biology department; E.S. Bernhardt, Duke University / Biology department. The development of high throughput sequencing and bioinformatics enabled microbial ecotoxicologists to better characterize the impact of stressors and especially pollution on microbial community structure. However, the overwhelming amount of information generated by sequencing and the high diversity of microbial communities led us to focus our analyses mainly at the community or phylum levels, ignoring all the key ecological knowledge potentially gained at the population level. In this study, we tried to move beyond bacterial classification by using a high-throughput sequencing data by characterizing the response of individual taxa (OTUs) to a multiple stressor gradient and identifying bacterial indicator taxa. Taking inspiration from classic genetic analyses used for macro-organisms in Ecology (Threshold Indicator Taxa Analysis - TITAN, logistic and quadratic regressions), we identified bacterial taxa that presented positive, negative, neutral or subsidy-stress responses to a well characterized urbanization gradient in 41 streams in the Raleigh-Durham area (North Carolina, USA). We used a combination of environmental variables (% development, % forested, sediment Zn concentration, biotic index) that were significantly correlated to bacterial community structure to identify reliable bacterial indicator taxa along this multiple stressor gradient. Using TITAN, we identified more bacterial indicator taxa negatively impacted by urbanization than positively impacted (138 and 56 OTUs, respectively). Using quadratic regressions, we found 140 OTUs presenting a subsidy-stress response to the gradient. We observed that two bacterial families were strongly and consistently decreased by urbanization: Acidobacteriaceae (Acidobacteria) with 50% of OTUs identified as pure and reliable indicator taxa and Xanthobacteraceae (Alpha-Proteobacteria) with 39% of indicator taxa. Positive responders were distributed all over the phylogenetic tree and the family Comamonadaceae (Beta-Proteobacteria) presented the highest number of indicator taxa (14%). We calculated with TITAN that the community-level threshold, indicating the peak along the gradient where the maximum decline in all negative responders happened, was at 12.1% development. This community-level threshold occurs at very low levels of urbanization patterns and expresses a high potential of microorganisms to urbanization and the potential of bacteria to be used in bioindication or monitoring along with more traditional indexes.

TU015

Dziuron sorption in freshwater biofilms: determination of isotherms

B. HAULMET, Irstea; T. Fournier, Tunis; A. Grisan, INRA; D. RABX

In 2000, the EU Water Framework Directive (directive 2000/60/EC) was implemented with the objective of reaching the good ecological status of rivers. 45 chemicals were indexed as priority including 19 pesticides. The biofilm is at the basis of the trophic chain in aquatic environments and considered as an excellent bioindicator for water quality assessment (Edwards and Kjellnerup 2013) because of its capacity to integrate contaminants displayed in the water. In this study, we used a photosynthesis inhibitor herbicide: dziuron, one of the priority substances to the EU Water Framework Directive. Previous experiments carried out in order to characterize dziuron bioaccumulation in biofilms, with two different concentrations, suggest that pesticide uptake by microorganisms was not proportional to contaminant concentration in the water. For this experiment, we supposed that dziuron absorbed from the water, then accumulated in the biofilms, and in order to confirm this hypothesis, bioaccumulation and toxic impact were simultaneously assessed at the equilibrium. To that aim, mature biofilm previously grown on glass slides

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during one month was exposed in channels at 6 increasing concentrations of diuron: 0, 1, 5, 10, 25 and 50 µg.L⁻¹ for two hours, with a flow velocity of 2 cm.s⁻¹. Then, Langmuir isoequation (Praus et al. 2007) was fitted to the bioaccumulation data. During the determination of the isotherm, a plateau was reached over 5 µL.L⁻¹ of diuron in the water. This suggested that all absorption sites were saturated, and then diuron concentration in the biofilm became independent of diuron concentration in the water. The fitting of a Langmuir isoequation allowed to estimate a maximum concentration in the biofilm of about 30,753 µg.g⁻¹, and an equilibrium constant of 0.378. Photosynthesis inhibition was correlated (R²=0.75) to diuron concentration in the water. The data did not clearly highlight a relationship between bioaccumulation and photosynthesis inhibition. This study establishes that diuron bioaccumulation in biofilm is nonlinear, and allows to calculate the equilibrium concentration of diuron in the biofilm.

The determination of the isoequation enabled to estimate the proportion of EPA, such as diatoms, are an excellent source of food for animals but could lead to their introduction in the environment occurring also via uncontrolled transfers. So that, it is crucial to have early assessment tools to evaluate effects of metals at the cellular level. In the present study effects of Nickel was evaluated on cell cycle progression, growth and antioxidant enzymes kinetic of the green algae C. reinhardtii. Synchronized cultures of this multiple fission dividing algae were used for the study. Nickel provoked a block of cell cycle at the highest concentration tested. At lower concentrations, cell cycle progression was observed with different pattern of attained CP, depending the exposure concentration. Antioxidant enzyme activities were inhibited at concentration above 0.05 and 1 mg/L. The effects of metal on pigment concentration was less evident than the effects on growth rates, indicating a lower sensitivity of these parameters. Nickel provoked severe damage on algal cell structure, cell cycle progression and photosynthetic pigments as well as induction of antioxidant enzymes activities. An integrated analysis is done discussing the consequences of population performance in natural environment affected by metal discharged from different anthropogenic sources.

TU/011 Use of BiologEcoPlateTM to evaluate the effects of ZnO nanoparticles on soil microbial communities

V. Romano, Parthenope University of Napoli / Science and technology; v. pasquale, University Parthenope; s. schiavo, ENEA CR; M. Oliviero, s. dumontet, University Parthenope; s. manzo, ENEA / SSPT-PROTER-BES

Nanoagrochemicals seem to be the new frontier in modern agriculture due to their increased efficacy and the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used nanoparticles in their system. This new technology could be evidenced by measuring metalic profiles of plant, leaf, root and shoot. The combination of biosensing technology using BiologEcoPlate™ allowed the evaluation of the effects of ZnO nanoparticles on soil microbial community. Biofilm from concentration in the water. The innovative coupling of toxicokinetic and toxicodynamic approaches would provide original information about pesticide exposure concen- trations (diuron and S. monuron) as well as impact in periphytic microorganisms.
Chlorinated solvent contaminated groundwater: a glimpse inside the environmental microbial communities and their potential for bioremediation
P. Porto, R. Ricci, Biosearch Ambiente; T. Lettieri, European. Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Chlorothi aeneus are among the most frequent pollutants affecting groundwater in North Italy due primarily to the extensive industrial use of these substances. As many contaminants released in the environment because of inadequate disposal, they accumulate and persist in the ecosystem posing a threat for human and environmental health. Degradation of such harmful xenobiotics can occur thanks to the activity of autochthonous microbial communities able to break down the more chlorinated compound to lesser chlorinated ethenes which need to be detoxified as well. Bacteria able to metabolize such toxic substances are indeed well known as well as many of their metabolic pathways, but still an efficient and complete detoxification process is hard to achieve. The understanding of the microbial activity underlying the whole process is crucial especially during a bioremediation process where microbes are stimulated through the amendment of nutrients in order to obtain the complete detoxification. The huge impact of metagenomics, and other molecular biology techniques for the comprehension of microbial composition and activities in different environments, is helping to shed light for the comprehension of the critical apparatus behind the detoxification process but we are still at the beginning. During the present work, two microbial populations inhabiting a chlorinated solvent polluted groundwater, with and without nutrient amendment, have been analyzed after whole genomic DNA extraction and sequenced. The data analysis, together with the chemical ones, will help to enlighten the differences between the two populations in terms of genes expression and potential of biochemical pathways for pollutants’ biodegradation in relation to the chemical and geochemical parameter characterizing the specific site. Metagenomics of polluted sites is a powerful tool that could help in the future to define the best strategy to employ in order to obtain a complete environmental detoxification. This approach will be useful both for companies operating in soil and water recovery and for policy makers.

Impact of the antihistamine fexofenadine on structure and functioning of less-leaf associated microbial communities
P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J. Zupbrod, University of Koblenz-Landau / Institute for Environmental Sciences; J. FahLMann, T. Br Odin, J. KlAminder, Umea University / Department of Ecology and Environmental Science; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

Effects of the antihistamine fexofenadine on structure and functioning of less-leaf associated microbial communities (e.g., bacteria and fungi) on aquatic microbial decomposers and the functions they provide are rather well-documented, while knowledge about effects of other microorganisms is scarce. In a recent study the antihistamine fexofenadine was shown to impact the microbial decomposition of plant detritus, however, the mechanistic basis for this remains unexplored. We therefore conducted a microcosm experiment where we microbially colonized two plant substrates (i.e., black alder leaves and hay). Both precolonized substrates were subsequently exposed towards fexofenadine at concentrations of 0, 2, and 200 µg/L. Replicates (n=10-15) were harvested after 15 and 30 days. Substrates were used to determine mass loss or preserved to estimate microbial communities’ structural or functional composition including fungal biomass, sporation of aquatic fungi, bacterial abundances, and functional enzyme activities. Furthermore, water samples were analyzed for dissolved organic carbon (DOC) quality or preserved to analyze total organic carbon. After 15 days of exposure, there was a tendency towards reduced decomposition of black alder leaves (~40%) in both fexofenadine treatments, while after 30 days, decomposition in the 200-µg/L treatment was increased by ~45% (but both not significantly different from the control). On the contrary, the decomposition of hay tended to be increased by fexofenadine exposure after 15 days. After 30 days no differences could be observed among fexofenadine treatments for hay, while generally more hay was decomposed than black alder. Accordingly, in water samples of the two substrates, substantial differences in the DOC quality were observed. Furthermore, fexofenadine exposure lead to minor treatments to an increased proportion of microbial-derived DOC. These observations suggest that the microbial communities’ structure and/or functional composition differ between the two tested substrates as well as among the antihistamine treatments. Moreover, potential implications in carbon and nutrient fluxes in exposed systems are indicated as the detected alterations in DOC quality may affect planktonic decomposer communities that are involved in DOC’s mineralization in surface waters. To gain an in-depth mechanistic understanding of the observed effects, we are currently analyzing variables related to microbial community structure and functioning.

Innovative tools and metagenomics for the monitoring of rivers and lakes: the European project INT CATCH
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Environmental Health; L. Mancini, Italian Institute of Health ISS; C. Mancini, AEoCM / Environment Health; M. Delledonne, M. Rossato, University of Verona; F. Fatone, Università Politecnica delle Marche; A. Farinelli, J. Blum, D. Bloisi, University of Verona; A. Cordioli, Azienda Gardensa Servizi S.p.A. Peschiera del Garda; P. Varotto, Azienda Gardensa S.p.A. Peschiera del Garda; A. Trittonel, Technical S.p.A. Milan; D. Calisi, Algoritica S.r.l. Roma; F. Giannoni, Algoritica S.r.l.; R. AlAbbadi, Boku University; A. Parsons, L. Parsons, Deinstmetion Ltd.d.; T. Runnalls, Brunel University / IEF; G.E. Brighty, Environmental Sustainability Associates limited; T. Licha, Göttingen University; S. Malamis, Athens Technical University; T. Knutz, Go-Sys; A. Merkoci, ICREA.

The European Project Horizon 2020 INTCATCH (Development and application of Novel, Integrated Tools for monitoring and managing Catchments) has the main goal to recommend and deliver new monitoring strategies for the monitoring of surface waterbodies in Europe. The tools foreseen by INTCATCH include sensors for the detection of heavy metals, nutrients, pH, temperature, pesticides, Escherichia coli, some of them are mounted on aquatic drones. An innovative tool of Intcatch is the portable sequencing laboratory/tool for metagenomic analysis that is performed in different surface waterbodies (e.g. Garda lake) selected through an analysis of the pressures. Bacteria are collected after concentration of water samples that are filtered by an automatic system applied on the aquatic drones. Using portable devices, the genomic tool allows the DNA meta-barcoding on-site, where samples are collected, and deliver the full bacterial composition of the water analyzed, including pathogens. The validation of the metagenomic results is performed with the use of traditional microbiological analysis of raw water. The metagenomic data can support the traditional analysis links the natural and anthropogenic pressures. Changes in the bacterial community can reflect variations in water quality, and be linked for example to the presence of unknown chemical substances or mixtures. In addition, given its capability to detect pathogens, such portable genomic tool can provide a valuable rapid readout in case of emergencies, that are increasing in frequency due to the effects of climate changes, such as flooding. Similarly, the metagenomics data, linked to the informations of the other tools, can be also be used for the identification of pollution sources because the proportions of the bacterial groups vary in relation to several stressors (agricultural, urban, living stock, etc.).

TU025 Tolerance of sediment-microbial communities to copper indicates lake contamination
A. Tili, Eawag / Department of Environmental Toxicology; C. Bonineau, Irstea Lyon; A. Dabin, Irstea Lyon-Villeurbanne / UR MALY; E. Lyautey, Universite Savoie Mont Blanc; B. Ferrari, Centre Ecotoxico EAWAGEPFL, S. Pesce, Irstea Lyon-Villeurbanne / Microbial ecology of anthropised river systems. In lakes, and fresh waters in general, sediments play a crucial role in biogeochemical cycles, and are often at the basis of the food-web. Heavy metals such as copper, zinc or silver can accumulate in lake sediments, which represent a risk for benthic microorganisms, with potential negative effects on the functioning of the whole ecosystem. Therefore, the goal of this field survey was to examine the interaction between bacterial communities in sediments, along with the concentration gradient of heavy metals in lake Geneva. Sediments were sampled with an Ekman grab sampler at four sites, located around the lake and close to the shore. Samples were analysed for total metal concentrations, organic matter content, abundance of metal-resistance genes (e.g. copA and cusA), bacterial biomass, and bacterial community composition. Moreover, tolerance of microbial communities to copper was assessed following the defined ‘trophic contamination treatment’ (TCT) concept by measuring the inhibition of bacterial secondary production and the extracellular enzyme β-glucosidase activity. Results showed a clear gradient of copper contamination, ranging from 30 to 350 mg.kg⁻¹ DM sediment. The results also demonstrated that chronic in situ exposure to copper induced a decrease of bacterial biomass and a structural shift in the community composition. Interestingly, tolerance measurements to copper were strongly and positively correlated to the copper concentrations in the sediments. Overall, our findings suggest that the microbial communities in sediments are a good indicator for metal contamination in aquatic ecosystems, and the suitability of microbial tolerance measurements to pinpoint specific effects of metals at the community level.

TU026 Current challenges and perspectives in aquatic and soil microbial community ecotoxicology
K.K. Brandt, University of Copenhagen / Department of Plant and Environmental Sciences; M. Schmidt-Jensen, UFZ – Helmholtz Ctre Environm. Research / Department of Bioanalytical Ecotoxicology; A. Tili, Eawag / Department of Environmental Toxicology

Assessing the impacts of chemicals still largely relies on approaches that are based on assays in simplified laboratory settings at the single-species or subspecies level. Yet, it becomes increasingly recognised that to draw conclusions on potential effects on ecosystems, it is essential to consider higher levels of ecological organisation, and more intricate risks on ecosystem structure and function. Microbial communities provide a large range of ecosystem services such as primary and secondary production, nutrient recycling, pollutant degradation, and are sources of biochemicals. Microorganisms are also primary targets for chemicals, which can lead to structural and functional alterations of microbial communities, with potential negative consequences for ecosystem functioning and environmental selection of antimicrobial resistance. Hence, a microbial community-level perspective in ecotoxicology is more important than ever. In this presentation we will first provide an overview on the current status of microbial community ecotoxicology research, in aquatic and terrestrial ecosystems, and to which extent this field is considered in environmental risk assessment of environmental we will describe the challenges within both aquatic and terrestrial microbial community ecotoxicology. Finally we will discuss future research directions in microbial community ecotoxicology to accurately assess and predict impacts of chemicals on ecosystems, and to develop specific response indicators of chemical exposure and effects.

TU027 Hydrodynamic conditions alter the tolerance of biofilm communities towards chemical stress
B.H. Polst, Helmholtz Centre for Environmental Research – UFZ / Department of Bioanalytical Ecotoxicology; F. Larra, Helmholtz Centre for Environmental Research - UFZ GmbH; S. Lips, Helmholtz Centre for Environmental Research UFZ / Department of Bioanalytical Ecotoxicology; C. Anlager, U. Risse-Buhl, M. Weitere, Helmholtz Centre for Environmental Research UFZ / Department of River Ecology; M. Schmitt-Janssen, UFZ - Helmholtz Ctre Environm. Research / Department of Bioanalytical Ecotoxicology

Biofilms in rivers are complex communities built of bacteria, fungi, algae and protozoa embedded in a matrix of extracellular polymeric substances (EPS). They are important hotspots for biogeochemical processes in aquatic systems. A variety of stressors can potentially affect the structure and function of biofilms. Therefore their tolerance to one stressor may be influenced by former exposures to another stressor. Community composition and physical structure is influenced in a complex hydrodynamic. Even though biofilms seem to respond to decrease with higher mean flow velocity and turbulence, the cell-to-EPS ratio increased. As the EPS content of a biofilm may influence the bioavailability of toxicants, differences in community tolerance towards herbicides are expected for biofilms grown under variable flow conditions. Still, the interactive effects of hydrodynamic growth conditions and herbicide tolerance are lacking. Using an artificial flow-through channel and water from the River Selke (Elbe catchment, Germany), we created heterogeneous flow regimes and related biofilm community structure and function to different mean flow velocities and values of turbulent kinetic energy. Taking the biofilms grown under such controlled hydraulic conditions, herbicide tolerance towards prometryn was tested according to the PCR assays. Focusing on the antheros and aquatic biofilm communities, we 1) investigated the algal structure, function and herbicide tolerance under different near-bed turbulences (diatom composition, photosynthesis) and 2) assessed the role of EPS in stressor interactions. The relevance of EPS content in combined stressor interactions was confirmed by using artificial EPS and algal cultures.

TU028 Does fungicide exposure alter interspecific relationships of aquatic fungi during leaf-decomposition? - A case study using species-specific qPCR assays
N. Roedig, University of Koblenz-Landau; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J.P. Zubrod, D. Englert, University Koblenz-Landau / Institute for Environmental Sciences; M. Kolbichak, University Koblenz-Landau / Institute for Environmental Sciences; C. Baschien, Leibniz Institute DSMZ - German Collection of Microorganisms and Cell Cultures; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bendschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

Aquatic hyphomycetes, a polyphyletic group of freshwater fungi, are considered an important part of detritus decomposition to individual species’ abundances quantified via species-specific qPCR assays. Using a factorial design, every possible single, binary and quaternary species combination of four different aquatic hyphomycete species (Alatospora acuminata, Heliscella stellata, Neocenturia lagunensis and Tetracladium marchalianum), was exposed to the monoculture mixture composed of four substances with different modes of toxic action (four sum concentrations, ranging from 5 to 2500 µg/L and a fungicide-free control; n=5, N=275). In monocultures, aquatic hyphomycetes exhibited different fungicide tolerance levels, with concentrations ranging from 500 to 2500 µg/L resulting in significantly reduced abundances. Interestingly, only the two tolerant species (i.e., N. lagunensis and T. marchalianum) were capable of degrading leaf material to a significant degree. Moreover, abundances of single species within the model communities as well as their functioning were governed by dominance interactions (e.g., one species outcompeting the other), probably as a result of competition for leaf substrate. Depending on the species composition, interactions...
resulted in an up to 99% reduced abundance of the inferior species. Species interactions were largely unaffected by fungicide exposure as dominant species where generally those identified as tolerant towards fungicide exposure. However, qPCR results revealed that one of the two sensitive species exhibited a significantly increased DNA yield in presence of the other one at field-relevant fungicide concentrations (5 µL/L). Species-specific qPCR assays proved to be a valuable tool for assessing ecotoxicological effects on well-defined ecological interactions within aquatic hyphomycetes. In the future, this technique might become an asset in aquatic risk assessment and environmental stress monitoring.

TU029  
Cyanobacterial Bloom in the Lake Varese: Characterisation of Microbial Communities by Metagenomic analysis  
D. Conduoto Antonio, European Commission Joint Research Centre / Directorate Space, Security and Migration; R. Loos, I. Sanseverino, European Commission Joint Research Centre; A. Lahm, Bioinformatic consultant; A. Beghi, F. Pandolfi, ARPA Agenzia Regionale per la Protezione dell'Ambiente della Lombardia; P. Genoni, Lombardy Regional Environmental Protection Agency; D. Napierska, T. Lettini, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit  
The increasing anthropogenic eutrophication and climate changes are contributing to the intense proliferation of cyanobacteria in waterbodies so causing a phenomenon known as bloom which may compromise the quality of drinking and recreational water. The dynamics of bloom events are not yet fully understood, however it is scientifically accepted that external factors such as water temperature, nutrient concentrations and light intensity, may influence the potential of a bloom. Our study focuses on the relationship between environmental factors and the composition of the microbial community of the lake Varese (Italy) for a period of several weeks before and after the bloom event. Sampling campaigns were performed on a weekly basis. Water samples were collected from the depht of 3 m, 1 m, and 0.5 m from surface depth for subsequent Cu isotope separation (~7 µg/L); while isotopic ratios Cu/65Cu were very low, a significant difference of isotopic ratios between the EPS fraction (0.25) and the cell fraction (0.35) confirms the potential protective function of the EPS matrix.

TU030  
Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope  
D. Genoni, Irstea Lyon; S. Pesce, Irstea Lyon; P. Baser, University of Bordeaux / Department of Biological and Environmental Sciences; J. Yang, Nanjing University / State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; H. Kronenberg, University of Gothenburg / Department of Biological and Environmental Sciences; X. Zhang, Wisconsin Department of Natural Resources / State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; M. Eriksson, Chalmers University of Technology / Department of Shipping and Marine Technology  
In small streams, microbial communities form river biofilms attached to solid substrates by producing extracellular polymeric substances (EPS). This matrix may act as a protective layer by limiting cellular contact with surface water contaminants. Thus, several studies have suggested that during biofilm growth, biofilm and EPS matrix thickness could limit cellular bioaccumulation. To test this hypothesis, 20, 20, 20, 20, and 20 days, respectively. Community function was assessed by induced Community Tolerance (PICT) using photosynthesis as the endpoint. Periphyton was exposed for 18 days to five copper concentrations, between 0.01 and 10 µM, in a semi-static test. The number of days sequencing yielded 7.1 and 5.7 million high quality 16S and 18S reads, and the average numbers of 16S and 18S Operational Taxonomic Units among the samples were 9405 and 1242, respectively. Analysis of UniFrac distances showed that copper significantly changed the eukaryotic community structure at concentrations as low as 0.01 µM. The prokaryotic community structure was changed at slightly higher concentrations (0.06 µM). A total of 23 taxa, including several species within the Proteobacteria, Bacteroidetes, Strunemopiles and Hacrobius classes, were identified as particularly sensitive to copper. Algal biomass, photosynthetic pigment profiles and primary production, were reduced at Cu concentrations of 0.06 µM and higher. PICT measurements confirmed that copper
induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

**TU033**
A Time-series Study of Soil Microbial Community Composition and Functional Shift in Biodiesel vs. Petrodiesel Contaminated Soils

D.L. Carr, Texas Tech University / Biological Sciences; M. Dong, Texas Tech University / Biological Science

The spilt of petrodiesel on land can irreversibly damage the soil ecosystem, and there are limited studies comparing petrodiesel and biodiesel impacts on soil microbial communities. Biodiesel has been considered as a viable substitute for petrodiesel, however, evidence indicates that biodiesel is more microbial friendly than petrodiesel is inconclusive. Previous studies of soil microbial community on contaminated sites failed to reveal the dynamic changes of soil microbial communities. This laboratory study compared the effects of petrodiesel and three types of biodiesel on soil microbial communities in sandy loam soils. Contaminated soil samples were investigated at day 0, day 7 and day 180 to evaluate their effects on the composition and function of soil microbial communities. Biolog EcoPlates™ were used to test the microbial community functions based on carbon utilization while soil microbial composition were addressed by 16s rRNA gene sequencing of V3-V4 regions. Results suggested that biodiesels were not statistically different from petrodiesel in terms of their adverse impacts on soil microbial communities. In conclusion, our results suggested that biodiesels should not be automatically considered under different pedo-climatic conditions and should the detrimental effects in soils persist beyond 6 months post contamination.

**TU034**
Evaluation of riparian groundwaters quality using microbial response to potentiometric Shift in Biodiesel vs. Petrodiesel Contaminated Soils

O. CHAMSIL, ECOBAL UMR5245 CNRS UPS INPT; E. Navarro, CSIC - Spanish National Research Council / Dept. Reursos marinos renovables; J. Sanchez-Perez, S. Sauvage, ECOBAL UMR CNRS UPS INPT; F. Comin, CSIC Spanish National Research Council; I. Antiguiedad, University of Pais Vasco; J. Bodoque, University of Castilla La Mancha; J. Charcosset, ECOBAL UMR CNRS UPS INPT; E. Pinelli, ECOBAL UMR 5245 CNRS UPS INPT

Contamination of ecosystems by pesticides, pharmaceuticals and trace metals becomes a major environmental problem. Freshwater algae are well known bio-indicators of river pollution but diatom indices do not allow to evaluate the specific effects of the contaminants. Their sensitivity to pesticides differs markedly among microalgae species and therefore the toxicity data for multiple species need to be used. In the present study, we measured the growth of the three most dominant species Desmodesmus subspicatus, Nitzschia palea and Navicula pelliculosa by an automated fluorometric microplate assay to evaluate the groundwater and river quality in four riparian wetlands in the south-west of Europe (Monbéqui (France), Saragossa (Spain), Bidassoa (Spain) and Toledo (Spain)). Four campaigning of water sampling were realized during contrasting hydrological conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by HPLC-MS or ICP-MS. PCA, ANOVA and co-inertia analysis results showed that algal growth was different between freshwater and groundwater. As expected, the green alga was sensitive to alkalinity, SO2, O2 and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to 2-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoyleconoline, carbamazine/ibérsatan/valsartan induced growth stimulation of N. palea and N. pelliculosa, respectively. Same records for pharmaceuticals were observed for the other three sites, excepted Bidassoa. Both extensive sampling and data analysis makes our approach a new useful bio-indicator for preliminary investigation of groundwater quality in order to predict the best location of quality water for human consumption (ATTENAGUA project).

Can trends in wildlife populations revolutionise our understanding of the impacts of chemicals on the environment? (P)

**TU035**
Can post mortem data be used to monitor population health in response in the barn owl?

J. Sveinsson, University of Oslo / Department of Physics; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences; M. Grung, A. Nielsen, University of Oslo / Department of Bioscience

Bees are increasingly facing multiple and interacting threats. One of the threats that have received increased attention lately is neonicotinoids: a group of systemic neuro-active pesticides that disturb the transmission of signals in the insect’s nervous system. In just a few years neonicotinoids have become the most widely used insecticide in the world, and protect a variety of crops against invertebrate pest. Despite being used in relatively small quantities, several studies have shown sublethal effects of neonicotinoids on honey bee health (Parks et al., 2012). Neonicotinoids are potent NICOT receptors that mimic natural neonicotinoids in field-realistic doses. However, ecological and physiologic traits vary among bee species and studies on honeybees may not provide satisfactory predictions for negative effects on other bee species. Using bumblebees, *Bombus terrestris*, the present study developed a new experimental method to quantify how chronic dietary exposure to the neonicotinoid imidacloprid affects learning, locomotor activity and consequently the ability to forage and thus pollinate in a non-Apis species. Bumblebees were exposed to three different dosages of imidacloprid through artificial nectar (sugar water), ranging from field realistic
levels (1 mg/L and 10 mg/L) to distinctly higher levels (100 mg/L) in a chronic exposure regime, lasting for eight days. To assess whether imidacloprid influences learning, the bumblebees’ ability to discriminate between blue nectar-filled (rewarding) and yellow water-filled (non-rewarding) artificial flowers were tested systematically in a flying arena. The bumblebees were tracked by cameras, allowing for analysis of the flowers choices, locomotor activity and all the flowers visited during numerous, simultaneous foraging bouts. This study shows the successful application of a new method to track bumblebee behaviour. Further, the study shows that learning and locomotor activity are negatively affected, in a dose-dependent manner, when bumblebees are exposed to imidacloprid. Moreover, we show that field-realistic doses of imidacloprid have negative effects on bumblebees.

**TU039 Sensitivity of honeybee larvae to PPPs and impact analysis based on EFSA Bee GD**

R. Becker, BASF SE; Agrarzentrum Limburgerhof; J. Lueckmann, Rifcon GmbH *on behalf of the ECPA NTA & Bee Working Group Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae or honeybee brood. In July 2013 the European Food Safety Authority (EFSA) published a guidance document on the risk assessment of plant protection products on bees (EFSA 2013). This document is intended to provide guidance for notifiers and authorities in the context of the review of plant protection products (PPPs) and their active substances under Regulation (EC) 1107/2009 (EC 2009). The main objective of this poster is to summarize industry data, for active substances and formulated products on honey bee larvae testing according to e.g. OECD 237 and OECD 239, in order to gain an overview of these results and the selectivity of different product groups. As a first step in the risk assessment, EFSA requires a screening step which consists of the calculation of risk quotients (RQs) for honey bee larvae. This considers exposure routes for the tested PPPs (applied as spray and off-field (PPP) dust and as seed treatments and granules) scenarios. Where a substance or use should not pass one of the screening level risk quotients, EFSA offers the possibility for refinement in a tier I risk assessment. This includes the refinement of exposure estimates from the screening step and also additional exposure routes, such as the exposure to flowering weeds in field margins and adjacent flowering crops. The second objective of this poster is to evaluate the impact of the proposed screening and tier I risk assessments on the pass/fail rate of currently available active substances and formulated products which is an ability of the scheme to correctly identify compounds of potential concern and consequently screen out those of low concern. The aforementioned analysis follows the principles described in the ECPC impact analysis (Miles and Alix 2013) and compared first the approach with the outcome based on laboratory data. in

**TU040 Honeybee brood studies according to Oomen and OECD GD 75: Is there a difference of the brood termination rate under semi-field and field conditions?**

I. Lueckmann, Rifcon GmbH; R. Becker, BASF SE; Agrarzentrum Limburgerhof; S. Schmitzer, IBACON GmbH; B. Szcześniak, Eurofins Agroscience Ecotox GmbH *on behalf of the ICP-PR Bee Brood Working Group and the Bee Brood Working Group of the German Ag Bienenbeschutz Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae and brood. Depending on the purpose (the risk assessment of plant protection products on bees (Apis mellifera, Bombyx spp and solitary bees)” (EFSA 2014), both, the Oomen brood feeding test (Oomen et al., 1992) as well as the OECD Guidance Document 75 (2007; OECD GD 75) are given as the two higher tier options to refine the risk on honeybee brood if concern is raised in tier I. Both methods focus on the brood termination rate (hereafter BTR) as the key endpoint. While the Oomen brood test investigates an artificial and worst case acute or chronic oral exposure scenario with a test item spiked feeding solution administered inside the hive (Lückmann & Schmitzer 2015) brood studies according to OECD GD 75 under semi-field conditions rely on a realistic contact and oral exposure scenario to bees comprising contaminated nectar and pollen after overshoot of a bee attractive crop. As the evaluation of historical data from field and semi-field studies according to OECD GD 75 showed a strong variability of the control BTRs (Becker et al., 2015), the performance of OECD GD 75 bee brood studies under field conditions was regarded as an option to get more reliable BTR data (Becker et al., 2015; Giffard & Huart 2015). The present poster compares control BTRs from Oomen feeding studies with BTRs obtained from OECD GD 75 semi-field and field trials and consider explanations for observed variations. Moreover, the possibilities and limitations of the three methods will be discussed.

**TU041 Does assessing of all brood cells of a hive reduce uncertainty and increase reliability of Semi-field honeybee brood studies (OECD GD 75)?**

J. Berger, G. Gonisui, M. Kleinheinz, B. Szcześniak, Eurofins Agroscience Ecotox GmbH; S. Knaebe, AES Ecotox GmbH / Ecotox Field The OECD guidance document 75 (2007) introduced a semi-field test method to assess the effects of PPPs on honeybee brood. The assessment of bee brood development over one brood cycle is conducted by mapping cells. It starts from the egg stage and the fate of individual cells is followed until hatch. For this purpose, pictures are taken at defined stages of the development cycle and compared to the development in separate control hives. Three parameters in regards to brood development are assessed and evaluated: brood termination rate (BTR) (number of the marked cells where a termination of the bee brood development was recorded, expressed as a percentage). This parameter is an indicator for the compensation of bee brood losses) and brood index (an indicator of the bee brood development, facilitates a comparison between different treatments). Due to the high variability of BTRs within treatments and high control mortality in several studies no definite conclusions regarding effects on brood were possible (Pistorius et al. 2012). To address this variance, effort was taken by the ICPPR bee brood working group and AGBienenschutz to improve the method, to compare historical data and give recommendations for future testing (Pistorius et al. 2012, Becker et al. 2014). Despite fulfilling all recommendations, high variability in brood termination and high control mortality is still evident in some of the conducted studies. For those studies data interpretation and conclusions are questionable. According to Wang and Görlich (2017) one reason for the variability of brood termination rates is that the evaluation of brood development is based on a limited, defined number of cells containing eggs. According to their opinion results might be different if all cells would have been chosen. They suggested that it would reduce the uncertainty to a minimum. In this poster the recommendation of Wang and Görlich (2017) is used to find out if uncertainty can be reduced by evaluation of all cells. The brood data used were collected according to OECD 75 during a number of studies, in the production of young queens, as the production of sexuals is essential for the maintenance of a healthy bumble bee population. However, assessing the production of young queens in semi-field trials is challenging. Many variables influence the number of produced queens, such as the right timing for the termination of the study or the condition of the colonies at study start. Based on data collected in the past years, different strategies to reduce the variability in the production of young queens were evaluated. Also, several parameters influencing this most important endpoint were analyzed. We tried to answer some open questions concerning the colony reproduction success, such as the experimental set-up can influence queen numbers and queen weights, how high the natural variation between colonies is and how the selection of bumble bee colonies for the studies can be improved.

**TU043 Higher-tier risk refinement of solitary bees in the field - is the well-known ‘focal species’ concept a suitable approach?**

J. Lueckmann, M. Faupel, J. Ludwigs, Rifcon GmbH According to EFSA (2013) bumble bees and solitary bees have to be considered in adequately in the risk assessment of honey bees in the risk assessments. However, suitable testing methods in the lab are currently partly available only (e.g. for acute contact & oral bumble bee testing, acute contact solitary testing) or under development (e.g. chronic oral bumble bee testing, acute oral solitary testing). Regarding appropriate species for solitary bees EFSA (2013) proposes Osmia cornutata or O. bicornis as test organisms for the risk assessment, and higher-tier semi-field testing with Osmia as proposed by the OECD GD 75 non-Apis pollinators. However, experiences from current field studies on Osmia show that exposure of adults and larvae is not necessarily given as these solitary bee species have a pronounced polylectic feeding behaviour that can result into a low exposure to a test substance (i.e. not being a real worst-case). In order to address this problem, the refinement of worst-case solitary bee risk assessments under realistic field conditions may be achieved by using a ‘focal species’ concept, where most appropriate focal solitary bee species can be identified to represent a worst-case choice per crop, application time and country/zone. Whereas this approach is well-known for bird and mammal risk assessment it has not been yet applied for
solitary bees. Here, we present the idea of a ‘focal species’ concept for solitary bees, its needs, refinement options, advantages and limitations.

TU044 Non-Apis (Bombaerus terestris) versus honeybee (Apis mellifera) acute oral and contact sensitivity - Preliminary results of ECPA company data evaluation

A. Dinter, Crop Science Division; N. Exeler, Bayer AG, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; C. Jenkins, Environ, H. Krueger, EAG Laboratories; A. Zicat, SynTech Research / Ecotoxicology; E. SOLER, TRIALCAMP SLU / Ecotoxicology; A. Molitor, Eurofins Agroscience Services GmbH; S. Vinall, Mambo-Tox Ltd.; K. Amsel, BioChemagrar GmbH; S. Haupt, IBACON GmbH; S. Kimmel, Innovative Environmental Services (IES) Ltd. / Ecotoxicology

A decline in some pollinator species has led to an increasing pressure on political decision makers and regulatory bodies and resulted in a changing of existing risk assessment paradigms and testing approaches. The published and already revised EFSA GD on the risk assessment of PPP on pollinators includes also the bumblebees and solitary bees. In the need to address long term effects on bumble bee and solitary bee species, a new European Non-Apis working group designed a ring test protocol to develop a first-tier chronic feeding test for bumblebees. Based on the recently published honeybee 10 day chronic feeding test guideline OECD 245 and the bumblebee acute oral toxicity test guideline OECD 247 a 10 day feeding test was set-up using dimethoate as reference substance. The response of adult Bombus spp. workers to the test chemical Dinmotho EC-400 (Perfeckthion) was evaluated within a 10 day feeding exposure. Endpoints of the acute toxicity test guideline OECD 245 were L50 (median lethal concentration) and LDD50 (median lethal dietary dose) values after 10 days and if possible the NOEC (no observed effect concentration) and NOEDD (no observed effect dietary dose). First results indicate that with this method reproducible results were obtained. The mortality in the control groups seem not to exceed 15 % (evaluation currently ongoing) and the overall food consumption allowed for a proper evaluation of the intended endpoints.

TU046 Standardization of method to test toxicity of stingless bees

The recently updated EFSA draft honey bee Guidance document also specifies other hymenopteran pollinators, like solitary bees and bumble bees, as groups to take into consideration when assessing the risk of plant protection products to pollinators. However no validated test protocol and consequently no extensive data set is available to compare sensitivities of other relevant pollinators to those of honey bees. Within the current project of the ICP-PR Non-Apis working group a start was made to develop a first-tier acute oral test for Osma spp. bees. Based on the honey- and bumble bee guidelines OECD 213 and OECD 247 an acute oral test was designed using dimethoate as reference substance. Osma bicornis and Osma cornuta were housed individually and fed a known amount of test volume per dosage. First results indicate that with this method reproducible results were obtained. In these tests, control mortality never exceeded 12 percent. Furthermore, sensitivities of O. bicornis and O. cornuta appeared to be rather similar, although O. cornuta showed a slightly less sensitive response, (which might be) due to its larger bodyweight. Hence, the L50-values after 96 hours ranging from 2.6 – 7.1 u.g./bee indicate that a validated and workable methodology has been set up and a guideline is within reach.

TU047 A method for a solitary bee (Osmia spp.) first tier acute oral laboratory test: an update

J. Roessink, Alterra / Environmental Risk Assessment; N. Hanewald, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE; N. Exeler, Bayer AG, Crop Science Division; E. Noël, SynTech Research; A. Schmurr, BioChemagrar GmbH; A. Molitor, Eurofins Agroscience Services GmbH; E. SOLER, TRIALCAMP SLU / Ecotoxicology; S. Kimmel, Innovative Environmental Services (IES) Ltd. / Ecotoxicology; J. Van der Steen, Alveus AB Consultancy

The recently updated EFSA draft honey bee Guidance document also specifies other hymenopteran pollinators, like solitary bees and bumble bees, as groups to take into consideration when assessing the risk of plant protection products to pollinators. However no validated test protocol and consequently no extensive data set is available to compare sensitivities of other relevant pollinators to those of honey bees. Within the current project of the ICP-PR Non-Apis working group a start was made to develop a first-tier acute oral test for Osma spp. bees. Based on the honey- and bumble bee guidelines OECD 213 and OECD 247 an acute oral test was designed using dimethoate as reference substance. Osma bicornis and Osma cornuta were housed individually and fed a known amount of test volume per dosage. First results indicate that with this method reproducible results were obtained. In these tests, control mortality never exceeded 12 percent. Furthermore, sensitivities of O. bicornis and O. cornuta appeared to be rather similar, although O. cornuta showed a slightly less sensitive response, (which might be) due to its larger bodyweight. Hence, the L50-values after 96 hours ranging from 2.6 – 7.1 u.g./bee indicate that a validated and workable methodology has been set up and a guideline is within reach.

TU048 2 Years of Solitary Bee Semi-field Ring Testing and Final Conclusions (ICPPR Non-Apis Working Group)

S. Knaebel, EAS Ecotox GmbH / Ecotoxicology; N. Exeler, Bayer AG, Crop Science Division / L. Franke, J. Fricke, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; M. Frommberger, Julius Kuehn Institut; T. Jütte, Julius Kuehn Institute; S. Kimmelm, Innovative Environmental Services (IES) Ltd. / Ecotoxicology; O. Klein, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicity Field; J. Lueckmann, Ricfon GmbH; H. Giffard, Testap; A. Rossbach, Tier3 Solutions GmbH / Field team; C.W. Schneider, BASF SE; A. Schmurr, BioChemagrar GmbH

The publication of the proposed EFSA risk assessment guidance document of plant protection products for pollinators highlighted that there are no study designs for non-Apis pollinators available. Since no official guidelines exist for semi-field testing at present, a protocol was proposed and two years of ringtests were conducted in 2016 and 2017 to develop a general test set-up. The ringtest design was based on the EFSA guidance document, ÖEP/PPO Guideline No. 170 and recent experiences discussing ringtests for solitary bee species of the ICPPR Non-Apis workinggroup in 2015, 2016 and 2017 followed by a workshop in 2017 to harmonise methodology. Ringtests were conducted with two representatives of a solitary bee species (Osma bicornis L. and Osma cornuta Latr; Hymenoptera, Megachilidae). These species are polylectic and can forage on a diverse spectrum of flowering crops. They are nesting in cavities. Both are common species in Europe commercially available and are widely used for pollination services. Several laboratories participated in the higher-tier ring tests. 8 semi-field tests were done in 2016and 9 in 2017. Two treatment groups were always included in the ringtests: an untreated control and dimethoate as a toxic reference item (optional other i.e. brood affecting substances (fenoxycarb)). In the study design adult bees were exposed in the tunnels during their reproductive period. Adult bees, as well as their offspring, were exposed to the treated pollen and nectar during development. Relevant endpoints for this study design are observations of the flight activity in front of the nesting units, nest occupation (i.e. number of nesting females), the production of complete cells and cocoons per female, the brood
termination rate during the larval development as well as the success of emergence of their progeny (F1-generation) in the following year. Based on the results of the ringtests over 2 years a draft protocol is available together with recommendations for the methodology needed. This includes how the cocoons incubation and hatching of bees can be synchronised with the onset of flowering, how fit solitary bees are out of season and which substance at what rate can be used as reference item for brood studies.

**TT049** Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach

T. Pamminger, BASF SE, Agrarzentrum Limburgerhof / Ecotoxicology; N. Hoffmeister, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE; I.C. Becker, New York State Dept. of Environmental Conservation / Biology; M. Bergtold, BASF SE

Plant protection products (PPP) play a vital role in modern agricultural practice. Nevertheless, their potential off-target effects on managed (e.g. Apis mellifera) as well as wild (most non-Apis species) bees have emerged as an intensively discussed topic. In current risk assessment A. mellifera is treated as a pure exposure surrogate in pollen to cover potential adverse effects of PPP on non-Apis bee species. However, as robust and scientifically sound information regarding the sensitivity of non-Apis bee species are scarce the validity of this approach has been challenged. As a first step to address this question we have compiled a comparative data set of the *Acetylcholine Esterase (AChE)* inhibitors sensitivities of 21 bee species, covering five of exposure to residues. Method functions and its data set was compilation with information on bee bodyweight, a trait likely influencing bee sensitivity to PPP exposure. Our phylogenetic controlled analysis shows that bee bodyweight is a robust predictor of bee sensitivity to AChE inhibitors and confirms that A. mellifera is particular sensitive to this class of PPPs. In contrast, many stingless bee species, are comparatively resilient to AChE inhibitors, especially when controlling for body weight. We discuss the consequences of these findings in the context of the global non-Apis bee risk assessment debate in Europe and the Americas.

**TT050** New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experiences

M. Persiuzzi, Tier3 Solutions GmbH; U. Zumkier, Tier3 Solutions GmbH / Regulatory Science; A. Rossbach, Tier3 Solutions GmbH / Field team; C. Wolf, Tier3 Solutions GmbH

With the growing concern for insect populations and an increased awareness of the importance of pollinators in the public opinion as well as in the regulatory context related to their protection, new methods have been developed that allow for the determination of residues as part of (semi-) field studies with bees in pollen, nectar and honey, studies on foraging behaviour as well as methods to adequately determine residues for non-standard uses, such as home and garden uses, ornamentals and granules with a slow release formula. The different methods are compared and advantages and potential pitfalls are illustrated.

**TT052** Normative Instruction 02/2017 - Brazilian risk assessment of pesticides to bees

F. Viana-Silva, C. Dias, L. Borges, K. Cham, C. Tonelli, R. Oliveira, A. Alves, iBAMA / DIQUA, CGASQ; R. Rebelo, iBAMA / CCONP

With the growing concerns about possible decline in pollinators which requires that efforts be made in the direction of identifying its possible causes and in establishing policies for protecting pollinators. The Brazilian Institute for the Environment and Renewable Natural Resources (iBama) is responsible for environmental assessments in the context of pesticide registration in Brazil. Since 2011 iBama is implementing the risk assessment of pesticides in Brazil and one of the main points of this assessment is to establish relationships between the exposure of bees to pesticides and the consequent mortality. In this context, it was published in February 2017 the Normative Instruction 02 (NI 02/2017) that establishes procedures to risk assessment of pesticides to pollinators. This is the first Brazilian specific regulation based on a risk approach, and in July 2017 iBama published a Manual of Environmental Risk Assessment of Pesticides to Bees which meets all the established requirements and is still being used. The main points of this Brazilian scheme are in line with the EPA scheme, yet there are nuances in the Brazilian scheme regarding which exposure routes were included in the risk assessment. Furthermore, the main points of this Brazilian risk assessment framework for bees will be compared with those adopted by other countries, considering both similarities and differences. Keywords: Pollinators, bees, risk assessment, Brazil.

**TT053** How the new Brazilian risk assessment framework for bees works

K.d Coelho, ADAMA BRASIL. / Regulatory Affairs; G. Weyman, ADAMA

The Environmental Assessment of pesticides in Brazil is performed by the Environmental and Renewable Natural Resources Authority (IBAMA) and comprises Environmental Hazard Potential Assessment and Environmental Risk Assessment. The hazard assessment has been established since 1990 but the Risk Assessment, although required since 1996, only started to be implemented by IBAMA in 2012 and has been developing further since then. Due to numerous global discussions on the decline of pollinators, in February 2017 iBama published the first ruling ("normative") to establish guidelines, requirements, and procedures for a systematic risk assessment scheme of pesticides for pollinators in Brazil. Further guidance for the scheme was issued later in 2017. The Brazilian overall approach is similar to EPA, but there are nuances in the Brazilian scheme regarding which active ingredients must be tested, and additional considerations for future which must be understood. Using hypothetical data from a mixture and a single compound, the methods described in the "normative" work for two use patterns, foliar and soil application, considering the main aspects of Tiers 1 and 2 of the risk assessment. Furthermore, the main points of this Brazilian risk assessment framework for bees will be compared with those adopted by other countries, considering both similarities and differences. Keywords: Pollinators, bees, risk assessment, Brazil.

**TT054** An epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan

Y. Kameda, Chiba Institute of Technology / Creative Engineering; E. Fujita, K. Tachibana, Chiba Institute of Technology / Creative Engineering

Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, acetamiprid, thiacloprid, clothianidin, dinofeturan, Thiamethoxam and Nitenpyram are popular. Their usage began from the beginning of 1990 and is increasing till 2008 in Japan. Recent annual total usage of these insecticides is not increasing, approximately 400 tons per year in Japan. It should be noticeable that the residual levels of neonicotinoid pesticides in foods are much higher than those in EU and the US and that some recent problems reported were largely attributed to the occurrence in Japan. The aim of this research is to reveal ecological risk assessment of honeybees including colony survival in Japan by ELISA analytical methods. The exposure assessment is conducted by neonicotinoids residue concentrations in adult honeybees, pupae, pollen and honey. These samples were collected from beekeepers around in Japan. Information about condition of colonies was also collected from beekeepers. Wild honeycombs were also collected. The six neonicotinoids were detected in all samples including honey, pupae and adults. Especially, more than ten times higher concentrations were detected in some of honey bee samples than those reported by previous reports in Europe, Canada and America. All colonies where adult honeybees were exposed by high concentrations were evaluated as abnormal condition such as CCDs, massive fatalities and sacbrood disease. Moreover, possibility of abnormality of colonies was strongly dependent on residue concentrations in adult honeybees. It was very interesting that ECV50 values of colony abnormality, derived from this epidemiological research, were not much different from LC50 of adult bees. The values and the ELISA screening techniques could be one of easy warning values for beekeepers which indicate possibility of colony abnormality.

**TT055** Thiamethoxam Honey Bee Large Scale Colony Feeding Study - Design and Interpretation

N. Ruddle, Syngenta Ltd / Product Safety; H. Thompson, Syngenta Ltd / Environmental Safety; J. Overmy, Syngenta Crop Protection; B. Habib, Syngenta Crop Protection LLC / Environmental Safety; C. Elston, Syngenta Ltd; M.A. Feken, Syngenta / Ecological Risk Assessment; S. Bocksch, Eurofins Agroscience Services Ecotox GmbH / Ecotox Honeybees; P. Thorbek, Syngenta / Environmental Safety; M. Hill, Eurofins AgroScience Services Inc

Honeybee feeding studies were originally developed to directly assess the insect growth regulating properties of neonicotinoids and designed to determine modes of action rather than effect levels. More recently there has been regulatory interest in conducting colony feeding studies to determine the pesticide level in nectar substitute (sucrose solution) which leads to colony-level effects, thereby allowing
for comparison with residue concentrations detected in pollen and nectar from treated and untreated crops. In 2016, a honey bee colony feeding study was conducted with thiamehoxam with the aim of providing a robust colony-level endpoint for comparison with residues in pollen and nectar. Analyses of the colony data indicate there were clear significant effects at the highest concentration of 100 µg/kg for many colony parameters and overwintering survival. At 50 µg/kg, despite a few transient differences for pollen stores, overall colony strength and overwintering survival were similar to the control, confirming the NOAEL as 50 µg/kg. The NOEL was determined to be 37.5 µg/kg. To assess the potential risk to honey bees from exposure to thiamehoxam and metabolite CGA322704 (clothianidin) residues in pollen and nectar, the NOEL and NOAEL can be compared to measured residues in treated or untreated crops. In a treated oilseed rape-exposure study (Pilling et al., 2013) the maximum thiamehoxam residues found in pollen and nectar were 1.0 µg/kg and 3.0 µg/kg, respectively. The residues of CGA322704 were below the 1.0 µg/kg LOQ. In an on-going study, residues in pollen and nectar in untreated succeeding crops of sugar beet were also found to be low. The maximum thiamehoxam residues in pollen and nectar were 2.6 and 0.55 µg/kg, respectively. A maximum CGA322704 residue of 6.3 µg/kg was detected in pollen, while residues in nectar were less than the 1.0 µg/kg LOQ. The colony NOEL and NOAEL concentrations are an order of magnitude greater than the maximum residues in succeeding crops and a treated crop. The colony NOEL and NOAEL provide the basis by which to evaluate the potential risk of thiamehoxam residues detected in pollen and nectar. It also provides additional support for the lack of effects reported in field studies following exposure of colonies to residues of thiamehoxam in pollen and nectar of seed treated crops that are an order of magnitude lower than the no effect level observed in this study.

TU056 Alteration of the alternative splicing pattern in honeybees' nervous system genes as a tool to test pesticides toxicity

P. De et al., Unesp Universidade Estadual Paulista Júlio de Mesquita Filho; T. Rost, Unesp Universidade Estadual Paulista Júlio de Mesquita Filho / Biological; O. Malaspina, Unesp Universidade Estadual Paulista Júlio de Mesquita Filho / Department of Biologia, Centro de Estudos de Insetos Sociais; M. Soller, University of Birmingham

Evidence-based knowledge on pesticide-effects on pollinators, such as honeybees, has become mandatory in many countries. It is important to establish lines of action approved internationally to provide farmers and policy-makers more information about the applications of pest management programs. With this in mind, this work evaluated whether sublethal doses of the insecticide thiamehoxam, the fungicide carbendazim, and the herbicide glyphosate would be capable of altering the alternative splicing pattern of the Dscam (Down syndrome cell adhesion molecule) gene, which has an important role in the formation of nervous system. Elav encodes proteins commonly used as neuronal markers in metazoa, which has action on post-transcriptional regulation and is required for differentiation and maintenance of the nervous system. Whereas that, Dscam gene can suffer alternative splicing from a highly variable region and be able to generate more than 38,000 isoforms and it is important for growth and connection of mushroom bodies, a center of learning and memory, for the expansion of dendritic fields. Based on this, we injected 2 µl of each of the pesticides (0.01 mM Thiamethoxam, 2 mM Carbendazim, 47 mM Glyphosate) to the abdomen of forager bees. After 24 hours, the brains were dissected for RNA extraction. We analyzed alternative splicing of Elav and Dscam isoforms by reverse transcription-PCR and compared it to the control (with one P32 γ-ATP radioactively labeled primer for Elav and Dscam). Because the PCR products have very similar sizes but differ in sequence, we digested the PCR products with restriction enzymes and then separated these fragments on denaturing polyacrylamide gels. It was not possible to observe a differentiated pattern of splicing for Elav neither for Dscam, comparing the control groups with the bees exposed to pesticides. The doses used and the exposure time in our study was not sufficient to indicate these genes as biomarkers inApis mellifera. However, further studies are needed, exploring different doses, contamination routes, and increasing the exposure time to verify if these pesticides are capable of altering the alternative splicing pattern of genes directly related to the nervous system. (Fapesp: 2015/22268-5).

TU057 Non-uniform distribution of treated sucrose solution via trophallaxis by honeybees affects variability of homing success rate, gene expression and mortality among replicates

L. Jeker, Swiss Bee Research Center / Agroscope; Y. Christen, University of Applied Sciences and Arts Northwestern Switzerland

We compared the impact of the feeding regime group dosing with 10 bees versus group dosing with two bees per cage on the variability of the homing success rate, gene expression and mortality. Based on our own observations and the recently published publication (Brodschneider, R. et al.) it seems that food sharing via trophallaxis might lead to a non – uniform distribution of the tested sucrose solution between caged bees. This can cause high variability on measured parameters among group members, replicates and treatments. For homing success rate and gene expression endpoints, bees were orally exposed to different sub-lethal concentrations of thiamehoxam (TMX) at 0.1, 0.3 or 1 ng/bee, based on the honey flight ring-test protocol. For mortality, bees were exposed orally to dimethoate at 0.033, 0.07, 0.1, 0.13, and 0.35 µg/bee, based on the acute oral toxicity test guideline OECD 213. For both methods, the treatment-feeding regime, was conducted with ten bees/cage and two bees/cage. Homing flight success rate, at 1ng TMX/bee, was significantly lower with ten bees compared to the two bees approach. A large variability of success rate and gene expression in trophallaxis treatment was found in the ten bees feeding group. Acute toxicity data with dimethoate showed that group feeding scheme with ten bees per cage resulted in higher mortality when compared to two bees (at same dosing levels). As consequence, the LD50 value is higher for the latter. High variability of homing success, gene expression or mortality rate in the ten bees feeding scheme is most likely caused by inhomogeneous dose distribution among bees, or either by over- or under dosing of single bees within replicates. A more accurate and uniform dosing distribution can be expected between 2 bees resulting in less variable data between runs, replicates and treatments. We highlight that feeding in smaller groups of honeybees should be discussed and considered to minimize the trophallaxis dependency regarding food distribution in group dosed honeybees. Moreover, to compare endpoints of toxicological studies with single dosed wild bees for regulatory purposes. <br clear="all" />

TU058 Modelling and validation of honeybee foraging behaviour for the pesticide risk assessment

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; C. Dietrich, WSC Scientific GmbH

In recent years a number of population models have been developed for honeybees and thiamethoxam has been used for pesticide risk assessment. While the in-hive development of honeybees is relatively well understood and can be evaluated relatively easily in models, the accurate estimation of exposure is more complex and more difficult to validate. In particular, foraging behaviour, which is included explicitly only in very few models, plays an integral role for exposure, since it determines to what extent foragers collect nectar or pollen from treated or untreated crops and other habitats, or if they find alternative food sources. Foraging behaviour is also tightly related to weather. We therefore evaluate how foraging behaviour can be implemented and validated in a honeybee model simulating natural conditions, with particular focus on the risk assessment of pesticides and on the protection goals formulated in the recently published honeybee guidance.

TU059 Automated waggle dance decoding

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; J. Kleinmann, A. Görlich, WSC Scientific GmbH

In honeybee field studies EFSA recommended in its latest guidance that field studies should ensure that the 95th percentile is met. Practically, it is challenging to confirm where honeybees actually foraged. In recent years a variety of methods have been developed and tested to establish a kind of foraging maps, based on waggle dance observations analyses, harmonic radar or RFID chips. Most of these, however, can realistically be used only based on relatively few individual bees. We therefore explored options for an automated analysis of waggle dance in honeybees. The system should facilitate the use of standard hives and should be usable without a computer in the field. We evaluate the reliability of the method.

TU060 How to increase test power and understand risk in refined honeybee trials

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For honeybee semi-field and field studies EFSA defined SPGs (specific protection goals) in its latest guidance document on the risk assessment of plant protection products (PPP) on bees. Detrimental effects on colony size as a result of PPPs should not exceed a 7% threshold to not endanger the fulfillment of the ecosystem service provided by honeybees. The measurement of effects on colony size as small as 7% is often difficult to achieve due to high uncertainty and variability both reducing the test power. By applying a modified field methodology and test design the test power can be increased substantially thus allowing to conduct field studies that are able to reach the SPGs. For the semi-field study colonies with sister queens of equal strength were used. From these a subset of colonies was selected based on hive assessments, which started approximately four weeks prior to exposure, by selecting those colonies that would be similar during the exposure phase. During the whole study the colony strength was assessed by photographing all hives every day. All frames of all hives were also photographed to assess brood development and to obtain a full overview of the condition of each hive at each time point. It is shown that by applying a refined, new field methodology and test design for field studies on honeybees the
test power referring to the number of adults can be increased. Assessments of complete hives, including adults and all cells, make it possible to gain a detailed insight into the development of colonies and hive parameters over the course of time. Environmental factors and their influence on different hive parameters can be assessed and used to explain how these parameters either alone or in conjunction with plant protection products have an impact on the strength and development of honeybee colonies.

TU061 The potential for immune activation and possible consequences for bees upon exposure to microbial pest control agents

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Microbial pesticides are unlikely to cause disease in non-target insects due to a lack of specific pathogenicity. However, simply exposing the insect to a microbe has the potential to activate subclinical responses that can lead to colony level effects. For example, injection with a non-pathogenic, microbial immune elictor induces a massive antimicrobial peptide response in bumblebees and honey bees. This immune response lasts several days and is costly to maintain. These costs are demonstrable through trade-offs between immunity and other life-history traits such as learning and longevity. In addition, immune activation alters many aspects of normal colony functioning, such as changes in foraging activity, decreased queen attendance, modified feeding behaviour, increased production of sexuals and forced ejection. Crucially, many of these effects only become apparent in the colony, and show specificity between bumblebees and honey bees. The established paradigm uses laboratory trials as a ‘worst-case’ scenario before progression to higher tier field trials, which may mask the downstream immunological impacts on endpoints such as longevity. Evidence exists for immune activation in insects via oral exposure with non-pathogenic bacteria. We therefore propose the need to establish whether oral and cuticular contact with microbial pesticides can induce the immune system in bees. Should immune activation be confirmed in the laboratory in the absence of lethal effects, further field trials may be required to reveal the consequences within the colony.

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (P)

TU062 Assessment of Levels of Some Heavy Metals in the Organs of West African Dwarf Goat and Beef Cattle in Ogbomoso, Nigeria

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The dangers inherent in the exposure to heavy metals present in food products especially meat, have aroused widespread concern for food safety and human health. With increasing human activities and anthropogenic pollution sources, there has been deposition of large amounts of various toxic metals in the food material which ultimately make their passage into the tissue. This study aims at assessing the levels of five heavy metals (lead, cadmium, zinc, copper and iron) in organs of West African dwarf goat and beef cattle slaughtered in Ogbomoso metropolis, Nigeria. Chevon and beef samples of heart, intestine, liver, muscle and tripe were collected from both sexes of two breeds of cattle and West African dwarf goats. Raw and cooked samples were digested and analysed using the method described by the Association of Official Analytical to determine the levels of the metals by Atomic Absorption Spectrophotometric technique. Results show that there were significant differences (<p < 0.05) in the concentrations of the metals in the different parts and sexes of the animals studied. The estimation of the non-essential metals in the investigated samples indicated the following range: lead: 1.11-6.00 mg/kg and Cadmium: 1.25-6.52 mg/kg while that of the essential metals are Zinc: 1.27-7.65 mg/kg, copper: 17.00-72.30 mg/kg and iron: 98.93-352.00 mg/kg. The results also revealed that the concentrations of lead, cadmium and iron exceeded the stipulated permissible limits. Higher-than-limit concentrations are observed more in the various parts of cows than in bulls of the two cattle species. There was, however, no significant difference (p=0.05) in the amount of these metals accumulated by both the buck and Doe. There was a major reduction in the results life-history tested exposed samples when compared with raw samples for all the metals analysed. From the various data obtained, it can be concluded that all the five metals are present in all the samples analyzed and their average concentrations are significantly high in most of the samples. Cooking lowered the amount of the potentially toxic metals in the meat samples.

TU063 Assessment of metal bioaccessibility, bioavailability and toxicity in soil using the earthworm

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Simultaneous contamination of ecosystems by various substances sets a challenge as regards to environmental assessment. One of the aspects is appraisal of pollutant bioavailability. Such an analysis was performed on a mixed contaminated site. The earthworm Eisenia andrei was exposed to different soils according to a contamination gradient. An integrated approach including a suite of biomarkers and chemical analyses was adopted to determine site toxicity. Parameters of the antioxidant system (catalase [CAT] and superoxide dismutase [SOD] activity), an enzyme of detoxification cation metabolism (glutathione S-transferase activity [GST]) as well as acid phosphatase (AP) activity and lysosomal membrane fragility of coelomocytes (neutral red retention time, NRRT) were used as tools. Overall toxicity endpoints (lethality, body weight change, reproduction) were assessed. Lethal effects were detected in some soils whereas chronic endpoints significantly decreased. A significant response of time-growing extent and consistency was recorded for SOD from to 2-28 days, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also was significantly decreased after 72 days. Toxicity was clearly correlated to the heavy metals concentrations found in the samples. However, little information is available on the environmental fate and ecological effects of Bi. This paper also summarizes the acute toxicity (LC50=416 mg Bi/kg) and biacessibility of Bi, and describes bioavailability and chronic effects of bismuth on the earthworm Eisenia andrei. In reproduction tests, adult earthworms were exposed to natural sandy soil spiked with Bi citrate. Results indicate that Bi fractions form decreased reproduction suckers collected at a concentration ≥ 75 mg Bi/kg and 0.005 mg bioaccessible Bi/kg. Bismuth had little effect on phagocytic efficiency of adult earthworm coelomocytes. After 28 days, BI concentrations in earthworm tissue increased up to 21.2 mg Bi/kg and reaching a stationary state at 212 mg Bi/kg of soil.

TU064 Assessment of subcellular metal-binding ligands in white suckers (Catostomus commersonii): are all the metals accumulated in the heat-stable fraction (HSP) detoxified by binding to metallothioneins

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Assessment of Toxicological Impact of Anthropogenic activities on Onitsha Stretch of River Niger in Southeastern Nigeria

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The impact of anthropogenic activities on an urban stretch of a major river in Nigeria with respect to endocrine disrupting compounds and heavy metal concentrations was investigated. Three sampling points were selected along the Onitsa stretch of River Niger, based on the inlets of different tributaries into the river. Heavy metal contents of the water samples were analyzed after acid digestion, while the endocrine disrupting compounds were analyzed using gas liquid 

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chromatography. The result obtained showed that six heavy metals with varying concentrations were obtained in the order of Zn>Pb>Cr>Cd>Co>Ni. The HPI and MI values were far above the critical values. Results also showed EDCs to include PAH, phthalates, PCDDs, PCDs, PBDEs, bisphenol A and PCBs. This study established that Onitsuka stretch of River Niger contains varying concentrations of heavy metals and EDCs. The stretch of that river is highly polluted, and anthropogenic activities are highly impacting negatively on the river. The study therefore need to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

TU065 Comparing metalic elements in corals from South Africa and the Mascarene Basin
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Coral reefs are one of the most bio-diverse biomes on earth. One of the many dangers that coral reefs face is the accumulation of metals and metalloids in the skeletal and tissues of the colonies. No knowledge exists on the state of metal and metalloid contamination in corals from the Western Indian Ocean (WIO).

Fragments of four soft- and five hard coral genera were collected from five sites in the WIO. Sodwana and Aliwal Shoal constituted the coastal sampling localities from South Africa. Three Mauritian outer-islands in the Mascarene basin (Agalega, Rodrigues, and St Brandon’s Atoll) were the selected oceanic sampling sites. Eight-out coral fragments were collected and analysed for 31 metallic elements using ICP-MS. The corals collected from South Africa contained a higher concentration of most of the metals that were analysed compared with the Mascarene Island samples. Corals without symbiotic algae could only be collected from the South African reefs, and contained the highest concentration of metalloids. Soft corals exhibited a different relative composition pattern of metals than hard corals. Some of the species showed a strong biota to water fractionation profile, while others were more like a conservative fractionation profile. This study established that Onitsha stretch of River Niger contains varying concentrations of heavy metals and EDCs. The stretch of that river is highly polluted, and anthropogenic activities are highly impacting negatively on the river. The study therefore need to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

TU066 Bioaccumulation, DNA damage and metallothionein expression in plants grown in heavy metal contaminated soil supplemented with sewage sludge
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Many anthropogenic activities have contributed to a release of contaminants, including heavy metals, into the environment. Since plants cannot leave polluted areas, it is, therefore, essential to possess a vast range of defence mechanisms that can reduce the toxic effects of heavy metals (HM). Contamination of soil and water with HM not only decreases the growth of plants but since metals can be accumulated in plant tissues they cause a severe threat to animals and humans the food chain. Identification of plants response mechanisms to contamination is becoming a prime objective in research since this knowledge can provide a solution for soil contamination and metal accumulation in plants. Studies on plants have demonstrated the ability of specific proteins - metallothioneins (MTs) to hyperaccumulate heavy metals, and play a significant role in their detoxification and overall oxidative stress. The physiological roles of MTs are not completely understood and much is still unknown concerning their characterization in many higher plants and animals. The main study was to evaluate the effects of fertilization of contaminated with HM soil by sewage sludge on the genotoxicity levels and the expression of metallothioneins in plants shoots and roots. The toxicity assessment was conducted using selected measurement endpoints: germination index, roots length, the severity of DNA damage, chromosome aberrations and the expression level of metallothioneins. Sinapis alba L. was chosen as a model plant for this experiment. Plants were grown for 28 days in a growth chamber where they were exposed to soil contaminated by HM from metallurgical activities and to contaminated soil amended with different concentrations of sewage sludge. The study showed the effects of sewage sludge on the level of genotoxic effects caused by heavy metals as well as on MT expression. As such, a significant increase in the expression levels of MT was observed in plants grown under metal stress conditions. Despite of the differences showed statistically significant changes between related conditions which means that presented assay can be used as a sensitive stress marker for phytoremediation process.

TU067 Chronic toxicity assessment of Ni contaminated rivers in Japan using Ceriodaphnia dubia for development of biotic ligand model for Japanese surface waters
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Ni is one of industrial essential chemicals and have been widely detected in Japanese surface waters. Soft corals contained relatively higher concentrations of most of the post-transitional metals that were analysed. Sinularia is the coral genus with the most elements at the highest concentrations. Pocillopora from SBR had very high concentrations of Fe and Cr, possibly due to several shallow shipwrecks in the atoll. Most of the elements tested had lower concentrations in the WIO than in certain regions of the Great Barrier Reef and the Red Sea. Iron was consistently higher in all corals collected during this study than in corals from other studies. Some metals, such as Cu, Ni, and Cd, affect fertilization success of corals. Very high concentration of Ni was reported in Sinularia (1300 mg/kg dm) from Sodwana. As ocean temperature rises and ocean acidification increases, metals can become more bioavailable to corals, requiring further study.

TU068 Cytochrome P450, fat and ageing: new insights into metal toxicology
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Toxic metals are among the most persistent environmental pollutants worldwide and have been implicated in metabolic disorders, including diabetes, obesity and neurological diseases. Long-term exposure to metals increase the susceptibility of healthy individuals to hematological and developmental disorders. Several genetic markers including metallothioneins, heat shock proteins and oxidative stress related genes have been used to assess metal exposure. We have been able to extend these tests on tissues from different organisms. Metalloproteins for markers for metals include cytochrome P450 (CYPs) a class of xenobiotic metabolizing enzymes that can transform compounds to either non-toxic or carcinogenic metabolites. Studies have shown that CYPs can metabolize important fatty acids and regulate lipid metabolism. Both CYPs and fatty acid metabolism have been implicated the ageing process and lifespan regulation, however the mechanism has not been fully elucidated. Cortical C. elegans is advantageous as model to study stress response mechanisms induced by metals due to some functional similarities with humans. Our aim was to study the mechanism behind the metal induced CYPs and fatty acid metabolism alterations leading to regulation of lifespan in C. elegans. Transcriptomics, viability, lifespan, gene expression analysis and RNA interference were used to explore the interaction between the CYPs, fatty acid metabolism and lifespan of C. elegans following metal exposure. C. elegans were exposed to metal contaminated environmental sample and lab reconstituted 12 metal mixture during post hatching larval stages (L1 to young adult). Transcriptomic analyses showed upregulation of cyp-33A1, cyp-35B1 and cyp-53B2 genes on exposure to both the metal mixture and environmental sample. Correlation with US soil surface waters was above 15 fold in the metal mix. LGI-1 and TGF-g expressed in C. elegans, both are toxic to the dauer buds. Fat staining with Nile red also showed significant increase in the level of stored fats on metal mixture and environmental sample exposure. Further, fatty acid metabolism related genes such as fasn-1, pod-2, aca-5 and fat-5 were also altered on exposure to both the metal mixture and environmental sample. Our results show that metals alter the CYPs and fatty acid metabolism and can have further implications on the lifespan of C. elegans. Understanding the interplay of CYPs and fatty acid metabolism can unravel possible mechanisms of metal induced onset of several diseases and their detrimental effect on the longevity of exposed individuals.

TU070 Determination of the effects of platinum in the oyster (Crassostrea gigas) using cell and tissue level biomarkers
R. MEDRANO, University of the Baquque Country; M. Abdou, UMR5805 EPOC / Geochemistry; M. Soto, University of the Basque Country / Zoology and Animal
Cell Biology. Research Centre for Experimental Marine Biology and Biotechnology PIER/UP/EHU; U. Izagirre. University of the Basque Country UPV/EHU / CEBT Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; J. Schäfer, Université de Bordeaux; B. Zaldibar, University of the Basque Country UPV/EHU / Department of Zoology and Animal Cell Biology. Centre of Experimental Marine Biology & Biotechnology Platini( ) is a test fish species of biotechnological interest in natural conditions, but since the 1970’s the strongly increased industrial use of Pt, especially for catalytic converters, has totally modified its global biogeochemical cycle increasing its presence in many natural compartments. Oysters have been widely used as sentinel organisms in environmental biomonitoring programs for decades because of their sedentary way of life and ability to accumulate pollutants with little metabolic transformation. The present work addresses the effects of Pt on the Japanese oyster (Crassostrea gigas ) at low levels of organization, such as cellular and tissue. For this, oysters were exposed to different Pt concentrations (Control = 0 ng L −1 ; Low = 50 ng L −1 ; Medium = 100 ng L −1 ; High = 10 µg L −1 ) for 3 (T3), 7 (T7) and 28 (T28) days. The condition index of each individual was calculated as well as the gametogenesis development stage. In addition, the histopathology of the oysters’ digestive gland was studied, including atrophy levels, tissue structure and parasite prevalence among other anomalies. Different histochemical parameters such as lipofuscin and neutral lipids were also measured and combined with autometallography to detect the location and quantity of Pt. An increase of autometallographical black silver deposits occurred at histological level. This experiment has shown that short-term (28 days) exposure to relatively high Pt concentrations in seawater do not induce alterations at histological level. However, the elemental levels of biological organisms in natural conditions, since they are considered to be more sensitive to chemicals compared with other aquatic organisms such as fish. Cu and Zn were chosen for study metal species due to their use and activity. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microplates (96 wells), and pH of test solutions was adjusted at 6.5. The algae growth was determined measuring the fluorescence (435/685 nm). In the first experiment, the microalga was exposed for 72 hours to each metal using three different types of culture medium, OECD modified OECD medium (mOECD) and Bold Basal Medium (BBM). In the second experiment, the microalga was exposed in a simplified test medium (destilled water buffered with MOPS and NaOH) only for 6 hours, as nutrients available for algae were limited. In the first experiment condition, the EC50 after 72 hours were 140, >1200 and 293 µg L −1 for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 34, 219 and 134 µg L −1 respectively and in BBM, they were >300 µg L −1 in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg L −1 for Cu, Pb and Zn respectively. The obtained EC50 of the metals differed between culture mediums. So the composition of culture medium affect the metal toxicity. Hence, we suggest that the simplified test medium may be an appropriate alternative to evaluate metal toxicity preventing interference of culture medium.

TU071 Ecological Risk Assessment of Trace Metal Contaminated Tropical Estuarine Sediment, Southwest Nigeria A. A. Uzere, University of Lagos, Nigeria / Department of Marine Sciences; O.L. Chukwu, University of Lagos Nigeria / Marine Sciences; R. Naidu, The University of East Anglia / Global Centre for Environmental Remediaion (GCER), Faculty Science and information Technology; M.M. Rahman, The University of Newcastle / Global Centre for Environmental Remediation GCER, Faculty of Science; S. Islam, The University of Newcastle / Global Centre for Environmental Remediation Faculty of Science and Information Technology; E.O. Oyewo, Nigerian Institute of Oceanography and Marine Research / Victoria Island, Lagos, Lagos lagoon, the largest of the eight lagoons that make up the lagoon systems of Nigeria has been under intense pressure from several anthropogenic influences over the years. This study evaluates the level of contamination and potential ecological risk of trace metal (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn) concentrations in surface sediment from 15 sites in Lagos lagoon during the wet and dry season by an Agilent 7500c (Agilent Technologies, Tokyo, Japan) Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The study was carried out using only one trace metals in the order Fe > Mn > Zn > Cu > Cr > Pb > Co > Ni. Cd rarely exceeded threshold element levels for the protection of aquatic life. Risk analysis using contamination factors (CF) and Enrichment factor (EF) suggests very significant enrichment from Zn and Cd as well as a high degree of contamination (Cd) from Cd (16.88-21.56) at locations closest to urban runoff, industrial activity, domestic and solid waste dumping. Estimated pollution load index (PLI), geochemical accumulation (Igeo > 0) index as well as the applied sediment quality guidelines (SQG) values by the World Health Organization (WHO) and United State Environmental Protection Agency (USEPA) indicates low to moderate degree of contamination from sediment metals concentrations and the unlikely risks to ecological receptors during the study period.

TU072 Effects of culture medium on metal toxicity and new approach for toxicity assessment G. Pascual, Tohoku University / Civil and Environmental Engineering; I. Garcia, T. Torcierta, O. Nishimura, Tohoku University / Architecture Civil and Environmental Engineering. Pollution of aquatic ecosystems is a global problem affecting the biological continuity of living organisms. In this context, metals is a group of pollutants occurring naturally in the environment, however human activity increase its concentration in the environment. Therefore, for environment surveillance purposes, metals entering aquatic ecosystems are regulated by water quality guidelines. The last one is based on the results obtained in toxicology tests using aquatic organisms, nonetheless the reported medium Effective Concentration (EC50) of a tested metal in a species widely varies. Here, our first purpose was to study the effects of culture medium on metal toxicity. Based on these results, our second purpose was to propose a new approach for the evaluation of metal toxicity on microalgae avoiding the interference of culture medium. In this study, we evaluated the toxicity of copper (Cu), lead (Pb) and zinc (Zn) on the microalga Pseudokirchneriella subcapitata, since they are considered to be more sensitive to chemicals compared with other aquatic organisms such as fish. Cu and Zn were chosen for study metal species due to their use and activity. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microplates (96 wells), and pH of test solutions was adjusted at 6.5. The algae growth was determined measuring the fluorescence (435/685 nm). In the first experiment, the microalga was exposed for 72 hours to each metal using three different types of culture medium, OECD modified OECD medium (mOECD) and Bold Basal Medium (BBM). In the second experiment, the microalga was exposed in a simplified test medium (destilled water buffered with MOPS and NaOH) only for 6 hours, as nutrients available for algae were limited. In the first experiment condition, the EC50 after 72 hours were 140, >1200 and 293 µg L −1 for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 34, 219 and 134 µg L −1 respectively and in BBM, they were >300 µg L −1 in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg L −1 for Cu, Pb and Zn respectively. The obtained EC50 of the metals differed between culture mediums. So the composition of culture medium affect the metal toxicity. Hence, we suggest that the simplified test medium may be an appropriate alternative to evaluate metal toxicity preventing interference of culture medium.
Arsenic concentration range between (0.55-1.53 ± 0.26) mg/kg and chromium was 0.04-0.16 ±0.02) mg/kg. Cadmium and arsenic concentrations were below detectable limit of 0.001 mg/kg while mercury concentration ranges between 0.04-0.61 ± 0.01) mg/kg. Calculated target hazard quotient (THQ) was highest in mercury with the value of 560.59 and the lowest value was obtained in Arsenic with 1.43x10⁻³. However, target cancer risk (TR) was highest for Lead with the value of 2.6x10⁻⁷. This shows that some lipsticks products popularly used in Nigeria contain high concentration of heavy metals such as Lead, Arsenic, Chromium, Cadmium and Mercury and they have high cancer risk. Therefore, public health awareness on the risk associated with the use of these cosmetic samples should be carried out.

TU075 Fatty acid profile of Cerastoderma edule and Scrobicularia plana affected by copper sulphate exposure
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At the past 30 years were recorded an intensive practice in the use of fertilizers and pesticides, mainly in the European Mediterranean region, that, in particular cases, exceeded the limits of regular legislations established by the European Union. The widespread use of these chemicals compounds and the pressure over agricultural fields near valuable ecologically coastal areas conducted to the implementation of monitoring plans to the recovering of aquatic ecosystems. Copper sulphate is used in industrial activities, but also it is much used in pesticides formulations, with application in agricultural activities, namely in rice farms to control pests. Studies reported that copper can affect biochemical processes, such lipid metabolism of some organisms and also changes in the copper uptake is still unknown. Nowadays, bivalve species are used in ecotoxicological bioassays due some particular characteristics, such as the wide distribution, ecological relevance, the capacity to filter and ingest large volumes of sediment particles and water and ease handling in the field and in the laboratory. Therefore, this work aims to determine toxic effects and changes in fatty acids profile composition of the two marine bivalve species Cerastoderma edule and Scrobicularia plana when exposed to copper sulphate, considering small (medium body size = 1.97 cm and 3.47 cm, respectively) and big (medium body size = 2.45 cm and 4.20 cm, respectively) size classes. In a first phase organisms were exposed under laboratorial conditions to copper sulphate to determine lethal concentration; at a second phase, it was assessed the FA profile and the nutritive quality of both species and size classes at the field and in the lab. Our results state C. edule is more sensitive to copper sulphate (LC50 = 0.818 (0.595–0.987) mg/L; 1.129 (0.968–1.289) mg/L, to big and small organisms, respectively) than S. plana (LC50 = 2.563 (2.229–2.903) mg/L; 4.705 (3.540–12.292) mg/L, to big and small organisms, respectively). Furthermore the last one presents greater abundance and variety of FA and essential fatty acids (EFA), notably DHA and EPA, rates than C. edule. Still, big size class of both bivalve species is the most affected by the contaminant.

TU076 Heavy metals in soil and vegetables of allotment gardens in the Cape Town, South Africa
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Increased industrialization has resulted in an unprecedented dissemination of toxic substances, among which are heavy metals, in the environment. Heavy metals are persistent environmental contaminants which ultimately accumulate in soil with possible translocation into the tissue of vegetables, thereby posing a potential risk to human health. While most research focus on major agricultural areas, less attention has been paid to the accumulation of heavy metals in home gardens, schools and rural areas where subsistence farming is increasingly used in South Africa as a means of poverty alleviation and increasing food security. This study was conducted to investigate the concentration of selected heavy metals in soil, water and leafy vegetables in informal and formal allotments of the Cape Town, South Africa. Thereby assessing the health risk associated with the consumption of vegetables grown in the informal agricultural sector. Soil, water and vegetables were sampled during winter and summer seasons from the study areas and were analyzed for heavy metals (Pb, Cd, Mn, Zn, Cr, Cu, Ni, Fe and Co) using Inductively Coupled Plasma (ICP). Results showed that there are no significant seasonal differences in the physicochemical properties of soil and water samples. The soil and water pH are slightly acidic, ranging from 6.30 to 6.90, and 5.60 to 7.00, respectively. Soil organic matter ranges from 1.7 to 13.5%. Results for water indicated that there was concentration fluctuation during winter and summer, with summer concentrations ranging from 0.062 to 0.947 mg/L while in winter the range was 0.002 to 2.347 mg/L. Soil heavy metal concentrations ranged from (0.59-1.209) mg/kg in winter and (0.52-1.127) mg/kg in summer. For both seasons the metal concentration in soil increases in the order; Cd < Co < Ni < Cr < Pb < Mn < Zn < Fe. The concentrations of all the elements in soil and water samples were within the permissible limits set by WHO and FAO. The concentration of heavy metals in vegetables were generally higher in summer (ranging from (nd - 116.26 m/kg) than in winter (ranging from nd – 144.28 mg/kg), with the general trend being in the order; Cd < Ni < Pb < Co < Cu < Cr < Zn < Mn < Fe. In general, the below-ground vegetables such as brinjals and green peppers exhibited lower accumulation tendencies than above-ground and leafy vegetables such as cabbage and spinach.

TU077 High-selenium-lentils offer a nutritional solution to combat arsenic poisoning in Bangladesh
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Background: Worldwide, the major chronic environmental threat to human health affecting over 100 million people, is daily exposure to naturally high levels of arsenic through drinking water and food, notably rice. Malnutrition increases the toxicity of arsenic. Low blood selenium specifically, increases the risk of arsenic-induced skin lesions and other manifestations of arsenic poisoning. Selenium, an essential element that interacts antagonistically with arsenic in the body, has been shown to decrease body burdens of arsenic and reduce arsenic-induced atherosclerosis in animals fed high selenium diets. Objectives: To reduce arsenic absorption, and therefore arsenic-associated toxicity in highly exposed people, through a dietary intervention with naturally high selenium lentils. This treatment is especially practical for populations already consuming lentils on a daily basis, as in the region notorious for chronic arsenic poisoning, the Indogangetic plains of northeast India and Bangladesh. Methods: For six months in a double-blind study, 400 participants with tube well As levels from 10 to 1200 ppb based on atomic absorption spectroscopy (AAS) analysis (WHO limits: 10 ppb for the west and 50 ppb in other regions) ate the same variety of lentils with high (0.854ppm) or low (0.029ppm) selenium because of the soil where they were grown. Urine, stool and hair samples were collected before, during, and at the end of the study, to determine arsenic levels and other physiological responses. Major outcomes: Mixed model statistical analyses determined that people consuming the high selenium lentils excreted significantly more arsenic than their urine (p<0.05) than those on the low selenium lentils, but there were no differences in stool As concentrations. Considering females only, there was a trend towards a difference in hair As on the 2 diets. Hair As decreased by 0.20 ppb in the high selenium lentil group, whereas it increased by 0.49 ppb in the low selenium group (p=0.07). Summary: This study has shown that selenium-enriched lentils have a potential effectiveness of a simple, whole food solution of consuming lentils naturally high in selenium to reduce absorption of arsenic from water and food.
column using this test modified OECD 29 test method, using a variety of sediments and conditions.

TU079
Modelling the chronic toxicity of copper to fish at low pH
S. Baken, European Copper Institute; K. De Schampheelaere, Ghent University (UGent) Applied Ecology and Environmental Biology
Bioavailability models account for the effects of water chemistry on metal toxicity to biota. They are a cornerstone of the environmental risk assessment of many trace metals, including copper. In this context, it has often been assumed that toxicity of dissolved copper to fish increases with decreasing pH. However, some studies show that this relationship may only be valid above pH 7. Below pH 7, the chronic toxicity of dissolved copper to fish seems to be independent of pH. Existing bioavailability models use the well-known mechanistic concept of the Biotic Ligand Model (BLM), but this modelling framework seems to have difficulties to reproduce the observed relationship of copper toxicity versus pH. This study was set up to refine the bioavailability models for chronic copper toxicity to fish, in order to better reflect the observed relationship between chronic copper toxicity and pH. The available chronic copper toxicity data to fish were reviewed. A new bioavailability model was developed using the concept of a generalized bioavailability model (gBAM). This semi-empirical model assumes a log-linear relationship between pH and effect concentrations (ECx) expressed as free cupric ion activity (Cu2+) and links it to the geochemical speciation model WHAM7 to predict toxicity on a dissolved copper basis. The existing bioavailability models were compared and contrasted to the newly developed gBAM. The underlying assumptions, advantages and limitations of each model are identified. Conclusions and implications for modelling copper bioavailability to fish are discussed.

TU080
Novel In-situ Toxicity Assessment of Sediment Capping Effectiveness in Deep Water
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A former mining site has been the subject of intensive restoration for the past few years, with significant focus on disconnecting mine spoils from groundwater and managing the quantity and quality of runoff. A remaining task is to ensure that concentrations of zinc in surface water of a large pit lake are reduced below water quality standards. An investigation was conducted to compare the efficacy of sediment capping materials for decreasing Zn dissolution during periods when the hypolimnion is anoxic and acidic (pH<5.5). Capping materials were selected based on results from laboratory batch testing and included Aquablok, limestone, and limestone + bonechar. Experimental field tests implemented novel methodologies, using Limnocorrals (LC) to isolate water columns above various capping treatments, simulating lake-mesocosms. Simultaneous in-situ and ex-situ toxicity tests were conducted using Daphnia magna, Hyalella azteca, and Chironomus dilutus. Test organisms were protected from temperature shock by pre-acclimating over 24 hrs and then deploying the test chambers in a Toxicity Assessment Container System (TACS), which protected the organisms from warm surface waters until reaching the bottom sediments and colder water. Test organisms were exposed to surficial sediments in reference LC or capping materials and overlying water. In-situ testing was conducted in waters and/or sediment cores collected from the bottom of each LC, and these tests were done at the same temperature as the in-situ TACS exposures (15 to 19°C, depending on deployment period). Results from in-situ testing demonstrated the usefulness of the TACS and provided similar results to the ex-situ testing. Preliminary results suggest organism survival is similar between in-situ capped and reference sediments; however, supplemental ex-situ analyses will help determine whether capping performance and toxicological response is indicative of site specific characteristics (sedimentation, capping type, cap layer attenuation) and/or cap specific indices (permeability, adsorption, ion exchange capacity). Results provided for more effective decision-making, with reduced uncertainty, than standard laboratory and chemistry only approaches.

TU081
REEChEaq - Rare Earth Elements Ecotoxicology in a Changing Environment
H. Tien, Hamburg University of Applied Sciences/University of the West of Scotland
Humans are exposed to the toxicity of rare earth elements (REE) lanthanum and gadolinium to the environment and their potential risk within ecosystems. REE are increasingly applied e.g. in green technology, and consequently also emitted to the environment. But there is a diversity of potential pollutant sources of which little is known, and no regulatory environmental framework for immissions exists so far. In addition, a review by Herrmann et al. (2016) demonstrated the considerable lack of reliable data for La toxicity in the aquatic environment. Considering their future use, release, and environmental fate, an evaluation of environmental risk from lanthanum and gadolinium will have to be based on information on exposure pathways, exposure and effect concentrations. The project REEChEaq addresses these topics in the following ways: (1) by studying the toxicity to aquatic organisms. Results on ecotoxic responses obtained for Alivibrio fisheri and Rhaphiodoncylus subcapitata so far are in the same range as literature data, and show a higher toxicity of Gd compared to La. Effect concentrations are of the same magnitude as for cadmium. (2) by substance flow analysis (SFA) for La and Gd, exemplarily performed for Germany. Information has been collected from published work for a variety of potential sources for La and Gd in rivers and lakes. Additionally, water and sediment samples have been analysed at specific locations. Current data point to wastewater and specialised industries as prominent sources of emission. (3) by investigating the impact of chemical environmental parameters (pH, redox, salinity) on the bioavailability of particle bound La and Gd. In a microcosm, a battery of miniaturized biotests was applied to monitor the toxicity responses in overlying water and sediment. This includes tests with Alivibrio fisheri, Vibrio proteolyticus Arthrobacter globiformis and especially Daphnia magna. Additionally, speciation and bioavailability of the La and Gd are examined following a procedure by Simpson et al. (2014), applying a cascade of different filters and a chelating resin. The presented poster will depict the results of the microcosm experiments along with the information on bioavailability based on biotests and speciation data.

TU082
Sediment characteristics of natural and anthropogenic origin and their possible association with benthic macroinvertebrates in a minimally affected river in South Africa.
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Sediment characteristics generally entail metals, minerals, organic content, elements, particle size conductivity and pH. The origin of metals in sediment may originate from anthropogenic activities including mining, industries, agriculture as well as aerial deposition. Limited attention is however given to the contribution that natural occurring phenomena play in the concentration of metals in the sediment. Weathering of minerals originating from the primary lithology can on the one hand add to the metals in sediments and on the other hand to the particle size composition. Although it is well known that chemical pollutants, due to anthropogenic impacts, act as a major determinant for the macroinvertebrates composition in surface waters the influence of the above mentioned components in a pristine river is less known. The aim of this investigation was firstly to determine the sediment characteristics and secondly to establish which of these characteristics have a significant impact on the macroinvertebrate community structures in the Main Olifants River. South Africa collects its water from three subbasins, the results of the study and the composition of the substrate at various sites, dried and sieved using an Endocott dry-sieving system to collect fractions <2000µm and <50µm. The total sediment samples >2000µm and clay fraction samples, 50µm were subjected to metal, scanning electron microscopy and minerals by X-ray diffraction analyses. Element anlyses were done by means of an FEI Quanta 250 FEG ESEM microscope equipped with an integrated Oxford Inca X-Max 20 EDS. Macroinvertebrates present in the benthos were collected for 15 minutes using a standard sweep net, preserved in 90% ethanol and identified up to family level. RDA redundancy analysis was constructed to investigate the distribution of macroinvertebrates Forty two families of which the vast majority associated with particles >2000µm, were found. Sediment particle sizes <2000µm had a detrimental effect on the biodiversity. No significant correlation was demonstrated between this group <2000µm and electrical conductivity and both diversity and abundance of macroinvertebrates. Although relatively high concentrations of selected metals were present in the sediment, it was largely from geological origin and most probably not bioavailable.Therefore, it can be concluded that, under these conditions, sediment particle size, played the decisive role on the distribution and abundance of macroinvertebrate taxa.

TU083
The effect of copper sulphate on the antioxidants enzymes activity of two size classes of Cerastoderma edule
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Anthropogenic activities, such as agriculture or industrial activities are the main origin of Cu pollution contamination to the environment. Copper may affect the living organisms of the aquatic systems. Copper is often released into the environment from geological origin and most probably not bioavailable as well as to aquatic pollution contributing to the degradation of the aquatic ecosystems and ecosystems. As a consequence, copper pollution can impact on the health of these ecosystems and the communities. Copper sulphate is a copper-based formulation, used in the agriculture practices to control pests. The main aim of this study is to determine the effects of copper in the antioxidant defense system of an important commercial bivalve species, Cerastoderma edule in two size classes. In this work was observed the behavior and activity of the organisms during the exposure time to copper sulphate and subsequently it was determined the antioxidant enzymatic activities of GST, GRed and GPx in the muscle tissue (foot). Moreover, lipid peroxidation was evaluated.
through thiobarbituric acid reactive substances (TBARS) measurement in the muscle tissue. The results showed changes in the behaviour and enzymatic activity at the different copper sulphate concentrations to both size classes. Moreover, according to TBARS levels, lipid peroxidation possibly occurred on the big size class of C. edule. The muscle tissue (foot) showed to be a good tissue to use in biochemical analysis to detect response to the exposure to toxicants.

TU084 The impact of single metals and mixtures in nature: a microcosm experiment

M. Van Ginneken, University of Antwerp, Dept. Biology / Biology (SPHERE); R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Even though environmental risks of metal-contaminated systems remains an important challenge. While laboratory experiments with metal mixture exposure are receiving more attention in the literature, little research has examined the interaction of natural stressors with metal mixtures. In the lab, we already performed experiments on Axellus aquaticus, exposing this freshwater isopod to a combination of metal mixtures and temperature stress. This way we could study effects on the individual level, and relate metal accumulation to relevant sublethal endpoints (e.g., growth rate, feeding rate). The present study, a microcosm experiment in a greenhouse, was designed to gain more insight into the effects of these metals on populations and communities. Small ecosystems with several species of macroinvertebrates were exposed to Cd, Cu, and Pb and a mixture of these three metals under semi-natural conditions. In each bucket, we placed Axellus aquaticus. Daphnia magna. Cryptococcus sterquilinus with different physiologies. Soil samples with different properties were spiked with Pb(NO₃)₂ at 9 concentrations of Pb to determine the effects of soil properties on Pb bioavailability and toxicity to E. crypticus. Survival and reproduction after 21 days exposure were related to total, 0.01 M CaCO₃ extractable and porewater Pb concentrations in the soil and internal Pb concentrations in the surviving animals. p₄₅₀ and pH₂₅ decreased with increasing total Pb concentration, but pH decreased much stronger for the soils with lower CEC and OC sorption. Porosity of Pb from the CaCO₃ extracts could be well described by a Freundlich isotherm (R² = 0.96-0.99) and Freundlich sorption constant Kₚ increased linearly with increasing cation exchange capacity (CEC) (R² = 0.86) or organic carbon content (OC) (R² = 0.76). Pb bioaccumulation in the encyrtids was soil-dependent, but differences between soils almost disappeared when related Pb bioaccumulation to available Pb concentration in soil. Toxicity values varied greatly among soils, with median lethal concentrations (LC₅₀) based on total Pb concentrations ranging from 246 to >3092 mg Pb/kg dry soil. LC₅₀ on the basis of total Pb concentration increased linearly with increasing CEC (R² = 0.70-0.90) or pH₂₅ (R² = 0.87-0.94). The differences in Pb toxicity among soils could be related to CaCO₃ extractable and internal Pb concentrations in soil (R² = 0.97) and internal Pb concentrations (R² = 0.97). Median effective concentrations (EC₅₀) based on total Pb concentrations varied 12-fold among soils from 81 to 1008 mg Pb/kg dry soil. EC₅₀ on the basis of total Pb concentrations increased linearly with increasing pH₂₅ (R² = 0.70-0.94). The variation in EC₅₀ was best explained by differences in the CaCO₃ extractable Pb concentrations in the soils (R² = 0.94). In general, pH was an important soil property affecting LC₅₀, EC₅₀ and internal Pb concentrations in encyrtids, as Pb availability, internal Pb, mortality and reproduction were inversely related to soil pH. Soil properties should be taken into account during the ecological risk assessment of metals in contaminated soils.

Safe by Design: responsible and innovative research for safe and sustainable chemistry (P)

TU087 In silico approaches to screen and design safer chemicals

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The prohibitive economic and social cost of testing, necessary to provide extensive information on fate and effects of existing chemicals to humans and the environment, highlights the need to focus on rational and safe design of chemicals before synthesis (i.e. Safe by Design – SbD approach). This approach applies the principle of green chemistry “Design safer chemicals and products,” and is useful to prevent hazardous substances from being developed and entering the environment, as well as to build safer alternatives to existing hazardous chemicals. While in the last decades computational chemistry and in silico models have been widely and successfully applied in the design of drugs with desirable pharmacological activity, these strategies have not yet been applied extensively in the design of sustainable, “safe by design” industrial chemicals as well as no real guidelines exist at the regulatory level. Modelling approaches based on Quantitative Structure-Activity Relationships (QSARs) rely on the assumption that biological activities/properties of chemicals are intrinsically dependent on the molecular structure. Endpoints like instance toxicities, physico-chemical properties as well as biotic and abiotic degradations can be predicted starting from models based on molecular descriptors of the chemical structure, which serve as basis to develop the SbD approach. Therefore, in silico strategies such as the aforementioned Qsar (and Qsar-like) models and multivariate analysis (MVA) can be successfully applied to screen undesired properties of large sets of chemicals in order to identify potentially hazardous compounds or safer alternatives. In this poster we show different examples of QSAR models mainly implemented in the software QsARINS and available at the freely distributed QSARINS-Chem module to screen “safe” from “unsafe” compounds on the basis of different endpoints of scientific and regulatory interest. Different classes of emerging pollutants were investigated using in silico models, such as Flame Retardants (FR), Personal Care Products and Pharmaceuticals (PPCPs) and nanoparticles. All the presented strategies support the identification of safer alternatives to chemicals that are screened by Qsar as undesirable from their molecular structure. The QSAR approach, applied for SbD before the chemical synthesis, provides concrete opportunities to increase the sustainable use of chemicals and to reduce the need for a posteriori remedial actions.

TU088 Application of chemometric methods and QSAR models to support pesticide risk assessment starting form ecotoxicological datasets

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This study conducted as a part of the national project ECOTOXI that main topic was testing applicability of several bioassays in assessment of cause-effect relation between levels of organic environmental pollutants in soils and its toxic and mutagenic response on samples organic extracts. Samples was collected in vicinity of Aluminum Plant Podgorica and pools of red sludge in Zeta plain. This area with intensive industrial activity is also reach with agriculture and is just in 5km distance from Podgorica (Capital of Montenegro). Waters of several rivers in this area, which are significantly influenced by municipal wastewaters of city, are abundantly used for watering crops in area. We tested mutagenic potential of samples organic extracts in the Ames test, on bacterial strain Salmonella typhimurium TA98, acute toxicity by bioluminescence test Vibrio fisheri and concentrations of possible dioxins present in the samples by DR-Luc test on rat H4IE hepatoma cell line. The obtained results indicate a strong mutagenic effect of organic pollutants mixture in tree samples collected near the Aluminum Plant and pools of red sludge, what was significantly in correlation with the recorded concentrations of dioxins in the DR-Luc test and with measured concentrations of polycyclic aromatic hydrocarbons, which exceed the maximum allowable prescribed concentrations. Two of tree samples, with high response, were in agricultural area. Even if it is a clear trend of decrease of mutagenic effects as well as reduction of the concentration of dioxins and PAHs with increasing distance of sampling sites from the Aluminum Plant and pools of red sludge, almost all samples showed a certain elevated level of mutagenic activity, which may be a consequence of the impact of multiple sources.

TU086 Toxicity evaluation of soils sampled in the vicinity of an Aluminum smelter in Montenegro using the Ames, Bioluminescence and DR-LUC bioassays

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The impact of single metals and mixtures in nature: a microcosm experiment

M. Van Ginneken, University of Antwerp, Dept. Biology / Biology (SPHERE); R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

The impact of single metals and mixtures in nature: a microcosm experiment
Concentration), both derived from chronic and long-term studies of a data sets of 70 active substances of plant protection products (PPP). The new Regulation for the authorization of PPPs requires that ecotoxicological endpoint values, derived from chronic or long-term studies submitted by the Applicant, are reported as EC50 or EC20 as well as NOEC. NOEC endpoints have been recently criticized since their values strongly depends on the experimental study design, whereas EC values are considered more appropriate because they take into account concentration-effect curve. Ecotoxicological data gathered from 70 active substances' approval dossiers were collected and stored into a database, and then analyzed to derive NOEC. Adequate statistical models were selected and used to calculate EC50, EC20, and EC10 with confidence intervals. In the present work, quantitative methods and models based on Structure-Activity Relationships (i.e. QSARs) were used to validate the Effect Concentrations of the active substances of the selected pesticides, and to predict missing data. The whole approach is mainly oriented to the aquatic environment, and can provide useful information to screen the potential undesired toxic effects of new pesticides, and of alternatives to existing active substances, starting just from the chemical structure.

TU089 Influence of coatings in the bioaccumulation of TiO2 and CeO2 nanoparticles in rainbow trout

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In the framework of the Project GUIDENano we investigated the effect of different metal nanoparticles (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on the the toxicity and bioaccumulation of these NPs trying to establish some relationships between coatings and the related effects. Bioaccumulation studies with rainbow trout have been performed for CeO2 NPs and TiO2 NPs of 4-8 nm uncoated and coated with citrate or polyethylene glycol phosphoric acid ester (PEG). OECD Test Guideline (TG 305 diet administration) has been followed. Fish (5±1 g weight) were fed for 10 days with a diet spiked with 100 mg/kg of the NPs dispersed in water. A control group fed with pellets containing the vehicle (water) was tested in parallel. This uptake phase was followed by a depuration phase of 42 days. Whole fish, stomach and intestine were collected at different time points (0, 10, 11, 17, 24, 38 and 52 days). In addition at the end of the uptake and depuration phase liver and gills were also collected. The levels of the metals in these tissues were measured by inductively coupled plasma mass spectrometry after an acid digestion. During the treatment and depuration phase, no signs of toxicity and no differences in fish growth or in the hematopoietic index among groups were recorded. At the end of the uptake phase levels of Ti could be measured in stomach, gills and liver without differences among TiO2 NPs. A difference was observed for the uncoated NP for which Ti levels in the fish were higher than for the other coated NPs. Ti levels reached basal values already in the first day of depuration indicating a very fast elimination of these NPs from the organism. Higher levels of Ce with respect to the control group could be measured at the end of the uptake phase in stomach, intestine and gills but not in liver. Ce levels were found in fish treated with the coated NPs but not in the group treated with the uncoated NPs. Levels of Ce could be measured the first day of depuration in stomach and intestine of fish treated with CeO2 NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO2 NPs uncoated or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO2 NPs. These results indicate a different behavior for the CeO2 NPs and TiO2 NPs. No relationship could be observed between the coating and the observed effects.

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TU090 Collodial characterization of nano-enabled products for the restoration of works of art: environmental fate of nano-ingredients

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The development of highly innovative techniques and technologies for artworks preservation is providing conservators with new engineered nanomaterials (ENM) and ENM-based formulations that can enhance performance and technical sustainability of art materials [1]. However, the human health and environmental impacts that may potentially emerge from these new materials and/or techniques are still little known and requires an adequate assessment and management of potential risks [2,3]. ENM formulations are increasingly preferred for conservation interventions compared to the corresponding bulk materials formulations because of their small size and enormous specific surface area that favour their interaction with the material to be conserved/restored. But the small size, coupled with their capacity to adsorb biomolecules, enables them to act like transporters to reach sub-cellular locations leading to potentially higher localized concentrations and toxicity. A lot of factors such as size, shape, surface coating and the fact that these particles are subject to fast alteration, make complicated the elucidation of the interaction mechanisms of these nanomaterials with the artefact material and the surrounding environment including the nano-bio interaction. In this context, in the frame of the FP7 DURAM 2010 nanoparticle project, different innovative nano-enable formulations for the conservation and restoration of modern and contemporary artworks have been provided, following a Safe-by-Design (SbD) approach. The safety of the new formulations was investigated by applying both EU CLP self-classification approach for mixtures (ECHA, 2017) and experimental in vivo and in vitro ecotoxicological tests. In order to better understand the key interactions occurring between ENMs and the biological medium in the tests, the colloidal characterization of the new formulations was performed by means of Dynamic Light Scattering (DLS) and Centrifugal Separation Analysis (CSA) techniques. Moreover, possible releases from outdoor conserved works of art were also investigated by immersion tests, simulating the exposure of the treated materials to the worst applicable environmental conditions (e.g. rain, humidity, temperature).

TU091 Considerations for Safe Innovation: The Case of Graphene

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In the context of the "Safe Innovation" project, in which we are involved within the framework of the 7th Framework Programme of the European Commission, we focus our interest on the safety and the environmental aspects of (nano)materials and nanoenabled products. We specifically look at the case of Graphene and investigate the possibilities of considering safety aspects during various stages of the innovation process. Based on this we suggest that in the first stages a clear description of the production processes and substances involved is needed in order to start the risk assessment and the production of the materials. In this way the standardization of the production process becomes important in order to reach a more reliable exposure assessment and enable use of exposure reduction measures where needed. Furthermore we outline what information on graphene is already available for assessing potential human and environmental hazard, exposure, and risks. For example a first indication of the hazard of an (intended) product can be obtained by collecting information on a limited number of physicochemical properties of the intended graphene product: dimensions, shape and surface properties. In addition, we recommend further steps to be taken by various stakeholders to promote the safe production and safe use of graphene. We emphasize that a safe and time-efficient innovation process is only possible under the conditions of clear and timely communication between innovators, scientists, risk assessors and regulators.

TU092 Safer-by-Design framework for supporting Small and Medium Enterprises early in sustainable innovation for nanomedicine

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One of the hot topics in nanomedicine is the use of nanobiomaterials for drug delivery. On the one hand, nanobiomaterials have various expected advantages compared to its bulk material: 1) decreased doses, 2) possibility to cross biological barriers, 3) increased drug efficacy, 4) reduction of side effects, and 5) targeted drug delivery. On the other hand, the nanosize brings new challenges for risk assessment of nanovaccine ic complex, and combines knowledge from different fields. It is at the junction among pharma, medtech, biotech, nanotech and chemical companies which are important economic and social player in Europe. In this context, the GoNanoBioMat project aims to facilitate SMEs in Europe in the decision making for developing and producing safer and sustainable polymeric nanobiomaterials for drug delivery. To do so, the consortium designed a GoNanoBioMat Design framework that supports the safe and sustainable use of nanomaterials in early stage of innovation. The framework comprises sustainable material design considering the whole life cycle of polymeric nanobiomaterials, environmental and human health risk assessment. Differences in the nanomedicine field arise at different levels which are at the research, regulatory and manufacturing levels. Nanomedicine is still considered as a young field and needs further research to better understand the interactions of nanomaterials at the bio-interface and to find out which are the critical quality attributes (link between physico-chemical properties and toxicity, product safety, quality and purity). Furthermore, there are difficulties in reproducing environmental and human health experiments for assessing the related
risks and having batch-to-batch uniformity. Finally, notifying bodies are behind development because of the uncertainties arising from this field. Therefore, it seemed important to include in the framework the following aspects: safe material's design, human health and environmental risks, manufacturing, storage and transport and the regulations related to the topic at hand. At the end of the project, the Safer-by-Design framework will be used as a structural backbone for creating national-specific guidelines on alkylcarbazoles. The guidelines aim to facilitate the communication among the different stakeholders in the value chain and with regulators for safe and sustainable innovation.

TU093
Review of the applicability of early-stage sustainability methods integrating toxicology and environmental assessments
C. Fernandez Dacosta, University of Utrecht / Copernicus Institute; P. Wassenaar, National Institute for Public Health and the Environment (RIVM); I. Dencic, Corbion; M. C. Zipp, RIVM / Centre for Sustainability Environment and Health; A. Morao, Corbion; L. Shen, University of Utrecht / Copernicus Institute; E. Heugens, RIVM / Centre for Safety of Substances and Products; L. Posthuma, RIVM / Centre for Social and Economic Research and Health. The chemical industry strives for the development of bio-based alternatives for present fossil-based chemicals driven by the transition to a bio-based economy. Key in this transition is “safe and sustainable by design”, which means safety and sustainability are taken into account at the earliest possible development stages. Many sustainability assessment methods are developed for this purpose. The aim of this study is to evaluate a selection of 12 early-stage methods (ESMs), their applicability, the relevance for bio-based chemicals and the coherence of their outcomes, using bio-based lactic acid as a retrospective case study. The selected methods contain at least one of the following themes: energy, climate change, eutrophication, land use, human toxicity and ecotoxicity. These six themes were considered as most relevant for the case of bio-based lactic acid. The selected early-stage methods were the right hotspots concerning energy and climate change, which is promising for application during process design. In general, the selected ESMs define simple environmental and toxicity indicators that have lower data requirements and are faster to implement than full assessment methods. However, the results they provide have intrinsically a higher level of uncertainty. Besides, the ESMs existing in the literature do not meet important criteria for utility. They are often not clear in the definitions of the environmental and toxicity indicators neither transparent in background data sources and not up-to-date. Important limitations of the selected ESMs are 1) narrow life cycle scopes (excluding the environmental impacts of material and biomass feedstock production) and 2) omission of some environmental aspects relevant to bio-based materials and toxicity. Despite these general limitations, within this study, we pinpoint limitations and positive aspects of several early-stage sustainability methods. Based on this exercise we identify and propose successful elements of existing methods to be included in a framework that supports the assessment of safety and sustainability in early development phase.

TU094
Liquid organic hydrogen carriers (LOHC) - comparative hazard assessment
M. Markiewicz, Technical University of Dresden / Sustainable Chemistry Group; Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry; S. Stolte, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry. Renewable energy stored in LOHC systems could replace fossil fuels yet their environmental impacts are largely unknown. This technology is still relatively new, and requires R&D efforts to optimise its performance to commercially attractive levels. This opens the possibility to proactively design the carriers for increased operational and environmental safety. A preliminary, comparative hazard assessment was performed using automotive diesel oil as a reference. The biodegradability and acute/subchronic (eco)toxicity using: enzymes (acetylcholine esterase), cell lines (IPC-811), bacteria (Vibrio fischeri), algae (Raphidocelis subcapitata), freshwater plants (Lemna minor) and invertebrates (Daphnia magna) were investigated. Test set included LOHC systems based on quinoline, ethyl-, propyl- and butyl-amine and each LOHC systems were used as following: H2-lean, H2-rich and partially hydrogenated. Low to moderate (eco)toxicity, comparable to automotive diesel oil, was observed for the quinidine LOHC system. No effect occurred in aquatic tests for H2-lean alkylcarbazoles due to unknown exposure. The H2-lean forms were moderately cyto-ecotoxic. High cytotoxicity was observed for partially hydrogenated alkylcarbazoles, with the effect increasing with the chain length. Alkylcarbazole LOHC systems were generally more toxic than diesel oil. None of the LOHC chemicals show appreciable biodegradation except quinidine. Further biodegradability test under less stringent conditions are needed to investigate potential persistence. Additionally, hydrophobicity of H2-lean and intermediate forms of alkylcarbazoles (log D 3.6–4.8) indicates that they might be bioaccumulative. Nonetheless, undeniable socioeconomic benefits come from the fact that LOHC energy systems can operate on renewable energies. Moreover, this LOHCs are more favourable in the terms of handling and transportation safety. The composition of LOHC systems is much better defined than it is in case of fossil fuels, which facilitates standardisation or quality control. This study also showed that many of the standard (eco)toxicity testing approaches are not well suited for LOHC systems showing moderate to high hydrophobicity as it is the case for diesel oil.

TU095
1-Octanol and 2-Butanone as biofuel candidates - Using “Green Toxicology” for biofuel development
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TU096
Investigation of the toxic effects of new mixtures of deep eutectic solvents (DESs) on the environment and human health
G. Mengotti, Heriot Watt University; A. Tagliati, Heriot Watt University / Institute of Life and Earth Sciences; E. Tagliavini, Heriot-Watt University; C. Samorì, University of Bologna; H. Johnston, D. Brown, Heriot-Watt University; T.F. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences. The development of environmentally benign and green synthetic protocols, due to the growing concern over the environment, has broadened the use of biofuels. The necessity to find greener, readily biodegradable and low cost solvents. This new concept of green chemistry has recently led to the synthesis of Ionic Liquids (ILs), from which have evolved in few years the deep eutectic solvents (DES).[1] These compounds are obtained mixing two components: a quaternary ammonium salt (e.g. ChCl) with different hydrogen bond donors, in such a ratio that the resulting substance has a significantly lower melting point than that of each individual component. DESs have proved to be environmentally sustainable and alternative to the conventional organic solvents in synthetic chemistry, able to increase efficiency of organic transformations. Those solvents have attracted widespread academic and industrial interests, and have found almost unanimous worldwide approval. Cosmetics has “flogged in the last years one of the most profitable industries. The majority of cosmetics are composed of chemicals, generally as emulsions. Given the ease of synthesis DESs, along with their low cost, it is thought to a possible use them in the formulation of cosmetic and beauty products. Some of these DESs contain nitrogen (N), which can be used as fertilizer in the growth of the crops. Another field of interest could be the agriculture as well: some of these solvents can be potentially used as pesticides, meaning of the fact that these new mixtures of DESs are not dangerous for the environment, as well as for human health. Toxicological studies on ChCl+Glycerol and ChCl+Levulinic Acid (never studied before) on algal species of the genus Symbiodinium clade B, known to be highly sensitive to environmental stress, for all the tested mixtures. Algae growth and Reactive Oxygen Species (ROS) production, a general indicator of stress, it is indeed not affected by all the tested compounds in the order of gL-1. Results from the present study indicate an expected safer

New frontiers in Life Cycle Inventory data collection and modelling (P)

TI/097 Predicting environmentally beneficial production pathways for chemicals with neural networks
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Life Cycle Assessment (LCA) has gained wide acceptance as methodology to evaluate the environmental impact of chemical processes. However, LCA requires detailed data on mass and energy balances. Data is usually limited for processes in stages of early development. For these cases, predictive LCA approaches are required. Current predictive LCA approaches employ solely molecular descriptors to estimate the environmental impacts of products. Thus, the choice between different production pathways towards the same molecule cannot be resolved. Therefore, we propose a neural network-based approach that uses both molecular and process descriptors. The resulting neural network is able to distinguish between various production pathways for the same product while still employing only data available at early stages of development such as stoichiometry. We estimate 5 impact categories including, e.g., cumulative energy demand (CED) or climate change (CC). The novel approach is compared to a neural network trained with molecular descriptors only. The results show that integrating process descriptors increases the coefficient of determination from 0.37 to 0.65 and from 0.39 to 0.65 for CED and CC, respectively. The route-specific prediction is illustrated for methanol production from CO; versus natural gas. It is shown that neural network models can serve as an initial screening tool for identifying environmentally beneficial new production pathways.

TU/098 A Study on the development of Food LCI DB and PCR for estimating environmental footprint in South Korea
S. Cho, SMaRT-ECO / Sustainable Business Div.; S. An, S. Seol, I. Kim, SMaRT Eco Corporation

As a result of the Paris Climate Convention adopted in December 2015, 195 countries in the world were required to implement greenhouse gas reduction, and Korea also proposed a 37% reduction target compared to BAU. In accordance with the environmental regulation trends of developed countries, Korea is also not free from environmental regulations at the time of preparation for active response. Under the Single Market of the EU, product environmental regulations starting from automobiles in 2000 expanded to include food in 2020, requiring the disclosure of high-quality environmental information on foods. As a result, the development of a high-quality environmental information database is accelerated, and the EU has created an ILCD Data Network to induce DB registrations in each country. However, Korea’s agricultural and livestock LCA DB does not meet the ISO requirements, it is time to revise. The purpose of this study is to develop the LCA database for the estimation of the environmental footprint (PEF) of major domestic food exports to Europe and to use the common protocol and food – specific guidelines (PCR) to estimate environmental footprints, and aims to obtain EPD certification of food. To do this, we benchmarked the protocol and PCR for the Korean conditions by examining the cases of the calculation guidelines of the developed countries. In the future, it is meaningful to construct a database that can be used as basic data for obtaining PEF certification for foods exported to Europe and overseas.

TI/099 Transition from ILCD To Environmental Footprint: changes in the database structure, format, nomenclature, methods and other adaptations.
S. Fazio, EC-JRC; O. Diaconu, JRC European Commission; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit

In 2013 a Communication from the Commission to the European Parliament (COM/2013/0196) established the Environmental Footprint (EF) scheme. The common methodology, nomenclature and recommended Life Cycle Impact Assessment (LCIA) Methods have been partly changed and adapted to fulfill the scope. Beyond that, the reference data contained in the ILCD package was found to contain some format, syntax and conceptual errors which were inherited from several data providers over time. Therefore a new database has been developed. Errors have been fixed, new files have been developed, and redundant or obsolete files have been deleted. The content of this presentation represents a synthesis, recalling general considerations or decisions, that have been applied for specific impact category, and technical details with respect to each impact category, documenting specific choices made when implementing the characterization factors, as well as problems encountered in the implementation. Furthermore, a list of changes made from the ILCD to the EF package, beyond the LCIA methods recommended (i.e. Elementar Flows, Flow Properties, Unit Groups) and complementary objects defining the compliance (i.e. stylesheets, schemas) are described, in a change log file available through the EFbLC website. Among the above mentioned and at once, the overall changes occurred in the ILCD-EF transition phase can be resumed as following: - 1242 obsolete or wrong elementary flows have been deleted / mapped - 560 new elementary flows have been created - Around 55.000 parameter values are different (this is mainly due to the introduction of new methods, and regionalization of some of them) - 37 duplicated flows have been eliminated - 275 wrongly categorized flows have been assigned to the proper category - 218 wrong/ duplicated or useless flow properties have been deleted and mapped to the remaining ones - 35 unit groups have been deleted, one new has been created.

TU/100 New tools for Environmental Footprint data checking and sharing: Soda4LCA, ILCD validator and Registry for the node management
S. Fazio, EC-JRC; O. Diaconu, JRC European Commission; O. Kusche, OkworX; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit

Several tools for Life Cycle Inventory data development, validation, sharing and registration to the Life Cycle Data Network (LCDN) have been released by the EC since 2013 and improved after the official launch of the LCDN (2014). All those tools were originally meant for the International Life Cycle Data (ILCD) scheme. Since 2013 after a specific EC Communication (COM/2013/0196) the Environmental Footprint (EF) scheme has been developed and led to significant changes in the structure of the ILCD/LCDN. During the development of EF compliant data, the tools had to be adapted and improved to fulfill new requirements. Particularly the following tools and software have been changed: - ILCD validation tool: software for the compliance assessment of datasets (format syntax, archive structure, nomenclature, links and orphaned items, categorization, etc.) - soda4LCA: software for distributing data based on the ILCD data format, with search and management functions, including the data registration in the LCDN - SMaRT - a dedicated tool: online registration facility that allows the transfer of data from nodes running on soda4LCA, and meant to make available only fully compliant data (while the nodes can host also intermediate data) - SMaRT: a dedicated registry has been developed for EF, with new functions. The compliance scheme is now visible (before was implicit since only ILCD was possible), possibility to register entire batches of data at once (before each single dataset had to be registered manually). Search interface improved.

TU/101 Improving the consistency and the accuracy of water inventories of chemical sites in PlasticsEurope LCIs in the perspective of the applicability of the international assessment methods
M. Baier, thinkstep / LCA; G. Castelan, PlasticsEurope / LCA

The ISO 14046 standard has clarified the definitions of water use and of water consumption which is the part of water withdrawn from a drainage basin not returned back to the same drainage basin. These only definitions have enabled PlasticsEurope to fix a number of important inconsistencies in its eco-profile procedures, where the use and consumption of water were sometimes treated as synonymous short term action, in perspective of enabling the application of the latest consensus water assessment method AWARE to the water consumption, PlasticsEurope and thinkstep have collaborated to improve the consistency of the data collection phase of water flows for the various projects of the program. For the purpose of good water management in a chemical plant, plant managers need to have a good knowledge of all the water flows inputs, their origin (lake, river, public supply or underground...), their treatment, in what equipment or process they are employed like for example in a cooling towers or being injected in the chemical process like in steam cracking. They must know the post-use-treatment and where all the outputs
end (back to the river, evaporated, in the public sewage network, in the product…). For the purpose of consistency of the Life Cycle inventory phase, it is then very important to report these collected operational flows in the ILCD input and output flows the right and same way whoever the LCA practitioner is. This will be the basis for the calculation of the consumptive water output (output minus input within the same drainage basin) and the application of AWARE. The presentation elaborates on the various operational processes in a water cycle and (for example) the life cycle inventory phase of the building stock and ILCD flow names. The PlasticsEurope methodology for calculating eco-profiles is extendable or adaptable to all sorts of industrial sites. A similar work would need to be conducted on all datasets so that the consistency of water inventory gets improved in both foreground and background data, enabling a better comparability of water footprint in order to get to LCA. The presentation aims to attack LCA (water) experts and scientists as well as people applying the water methods in practice to exchange on challenges, relevancy of aspects and to align on a continuous improvement of water data, regionalization efforts and method improvement in the future, to inspire broad application.

**TU102**
Methodological improvements by dynamic approaches for the life cycle assessments of buildings
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Nowadays in France, environmental and energy rules for the construction sector are based on environmental performances of products assessed through LCA methodology. However, the actual practice of LCA is lacking of temporal dimension whereas the temporal evolution during the long lifetime span of buildings has a non-negligible impact on overall LCA results. A new framework of LCA method was recently proposed by L.Barna et al. (2016) and A.Shimako et al. (2017) with a particular attention to the process and supply chains dynamics (web tool DyPLCA, http://dyplica.pigne.org/), aiming at calculating time dependent environmental interventions and the related impacts of toxicity and climate change. The aim of this study is to investigate the environmental performances over a large time span of two low-energy single houses, one on concrete and one on timber. The time dimension was integrated on both LCA steps (LCI and LCIA) using the framework cited above. The implementation of dynamic LCA took several steps. Buildings life cycles were first modeled in SimaPro 8.02 with ecoinvent 2.2 to calculate the conventional LCI. The calculated technological and environmental interventions matrix was then used with DyPLCA web tool for temporal LCI calculation. The temporal characterization of the product system considered two parts. Temporal characteristics of the foreground system were related to the building construction, materials replacement and renovation activities during the building’s life time of 100 years. The temporal characteristics of background processes were previously integrated in a dedicated database and used with DyPLCA tool. The temporal, L.E.I. Euremore interventions distributed in time, was then used for climate change impact calculation in function of time. Two indicators were calculated in function of time: mean temperature change and radiating forcing. The new method allows considering fossil and biogenic carbon for climate change proposes without clamping on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic method has improved our current understanding and a more consistent analysis of environmental impacts of buildings. However, simulation time and memory usage for dynamic LCI calculation can be a principal limitation for the practice of dynamic LCA.

**TU103**
Carbon footprint from Brazilian soybeans based on spatially-explicit life cycle inventories, including land use change
N. Escobar, University of Bonn / Institute for Food and Resource Economics IRL; J. Godar, Stockholm Environmental Institute
That location matters when it comes to quantifying environmental impacts of agricultural products is well known by the increasing interest in the LCA literature. Authors tackle the influence of spatial variability by capturing differences in agricultural practices, transport options and industrial processing sites in the life cycle inventory (LCI). This information is, however, incomplete when quantifying impacts of agricultural commodities that are produced in large amounts and traded worldwide, e.g. soybean. Despite the efforts from the Input Output platform to correctly capture these impacts, the analysis usually requires the use of aggregated resource consumption and emission data for environmental extensions, which provides little detail on the technological and logistic factors contributing to overall ecological footprints. From the LCA perspective, total nation’s supply is made of thousands of individual life cycles from farm to gate, for which LCI data is not frequently available. The Trade platform allows for real-world pathways of several internationally traded commodities to be annually mapped, from producing regions to destination countries. In view of its great potential for LCA purposes, our goal is to implement a carbon footprint module able to deliver results on CO2eq. emissions associated, on the one hand, to annual production of soybeans supplied from Brazil for the period 2010-2015; on the other hand, to every individual supply chain embodied in the whole supply of seed, oil, and cake to the international market. These include the following life cycle stages: land use change (LUC), soybean farming, domestic transport, export, and crushing, dealing with allocation challenges. In this way, our approach represents the convergence between top-down Multi-Regional IO analysis and bottom-up Attributional LCA. Preliminary results highlight the relevance of particular interventions that add up in the entire supply chain, mainly LUC, for which considering national scales is crucial in the quantification of climate change impacts. Outcomes support the argument that importing countries of soybean-based commodities should take responsibility on deforestation and associated carbon emissions, provided that spatial explicit data is available. This transparent tool is meant to provide science-based evidence to the ongoing debate on global responsibility, while assisting supply chain management and governance decisions.

**TU104**
Carbon Footprint Projections for Japan Using Computable General Equilibrium Models
Y. Ichisugi, Tokyo City University; T. Masui, National Institute for Environmental Studies; N. Isubo, Tokyo City University
In 2015, Science Based Targets (SBT) has been paid attention to the world. The targets adopted by companies reducing greenhouse gas (GHG) emissions to keep global temperature below 2 degrees increase from that of preindustrial revolution. Approximately 300 companies in the world declared to follow their targets. The target to the mitigation would be based on the calculated results of Integrated Assessment Models (IAM) such as Asia-Pacific Integrated Model (AIM), Integrated Model to Assess the Global Environmental (IMAGE). However, these results usually don’t consider the entire supply chain, because of the differences of the aims of application. In contrast, Life Cycle Assessment (LCA) considers the entire life cycle chain. On the other hand, the IAM and LCA models use different data and normally don’t include the dynamics of system. Therefore, this study aimed at the development of a dynamic evaluation of environmental impact method based on life cycle thinking to use both advantages of IAM and LCA. Currently, we try to develop the database using AIM developed by the National Institute for Environmental Studies (NIES). This model uses Computable General Equilibrium (CGE) which can estimate economic efficiency in the future, based on price mechanism in the market. In this study, we collect fundamental data using LCA database and estimate GHG emissions in the future considering the supply chain among industrial sectors. We estimated GHG emissions in 2005 as a tentative result in Japan. The total emission is approximately 1.13E+08 CO2eq. We confirmed the validity compared with the existing report published by the ministry of the environment in Japan. In the future, we will estimate environmental impact projection considering the scenario like Shared Socioeconomic Pathways (SSP).

**TU105**
Network LCA as a tool to enhance data collection and usage in a value chain context
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Keywords: LCA, data collection, value chain Life cycle assessment as defined by the ISO (14040) consists of four phases. First, the goal and scope are defined, after that the inventory analysis is performed followed by the life cycle impact assessment. At the end, the results are interpreted. The inventory analysis includes the product system. Therefore, data and information related to LCA is required. Firstly, it is seen as the most time consuming phase of every life cycle assessment study. This is because the data are collected from various sources and the sources might be from different organization than the commissioner of the study. Secondly, the data provider might hold their data confidential. This is because the recipes might be secret, i.e. the raw materials and the amounts of raw materials and/or the amount of energy consumed in the production process reveals the cost structure of the product. Thirdly, the data provider typically gets no benefit from delivering data and putting a lot of effort to collect and get together the data. This may decrease the motivation to deliver data. The fourth aspect is the unwillingness of data providers to reveal their performance indicators to competitors, if considered that their environmental performance is better than those of the competitors. Firstly, it is seen as the most time consuming phase of every life cycle assessment study. To tackle all the above mentioned four challenges. The main impact of network LCA is to provide science-based evidence to the company network level results, e.g. carbon footprint, which may be delivered to all network members openly. At the same time, all the network members can perform a local LCA computation to study their own local footprints. In other words, network members can independently run their own LCA, but rely on the network for the data from the upstream and downstream processes. The idea of network LCA is to use current environmental data and normally don’t include the dynamics of system. Therefore, this study aimed at the development of a dynamic evaluation of environmental impact method based on life cycle thinking to use both advantages of IAM and LCA. Currently, we try to develop the database using AIM developed by the National Institute for Environmental Studies (NIES). This model uses Computable General Equilibrium (CGE) which can estimate economic efficiency in the future, based on price mechanism in the market. In this study, we collect fundamental data using LCA database and estimate GHG emissions in the future considering the supply chain among industrial sectors. We estimated GHG emissions in 2005 as a tentative result in Japan. The total emission is approximately 1.13E+08 CO2eq. We confirmed the validity compared with the existing report published by the ministry of the environment in Japan. In the future, we will estimate environmental impact projection considering the scenario like Shared Socioeconomic Pathways (SSP).
The added value of using invertebrate species in ecotoxicology: new insights for environmental risk assessment (P)

TU106
Developing guidelines for elementary flow nomenclature
A. Edelen, ORISE; W. Ingwersen, US EPA
In general, a flow in life cycle inventory data refers to an input or output to a process. Flows may be of two broad types: elementary flows or intermediate (known as "technosphere") flows according to ISO 14044 (ISO 14044 2006). Elementary flows may be defined as all energy, space or that are used directly from the environment or released directly back into the environment. Life cycle assessment (LCA) data providers are currently not using a common list or system of elementary flows. An early activity within the UNEP-SETAC Life Cycle Initiative was the creation of a recommended list of flow exchanges by the Data Availability and Data Quality Workgroup (de Beaufort-Langeveld et al. 2003). Elementary flows in all life cycle inventory and life cycle impact assessment sources used in a model must correspond, or match, in order to build a functional LCA model. Edelen et. al. 2017 formulated recommendations on formatting and management based on a critical review of elementary flows from eleven LCA sources. These recommendations have been used to categorize flow information into three components and flow metadata into six components. These structured components of flows allows for systematic analysis and structuring of flow components through a knowledge organizational structure (KOS). The ISO 14048 standard was used to structure the different flow and metadata components as exclusive, inclusive or user-defined nomenclatures. The KOS is maintained in a user-friendly, publicly accessible interface through the US EPA terminology services. This research presentation will focus on describing the benefits of the KOS approach and the tools used to develop KOS, and provide an example application of the KOS to current elementary flow nomenclature. References [1] de Beaufort-Langeveld A, Bretz R, Hischier R, Huijbregts M, Jean P, Tanner T, van Hoof G (2003) Code of life-cycle inventory practice. SETAC Press, Pensacola, FL [2] Edelen A, Ingwersen W, Rodriguez C, Alvarenga R, de Almeida AR, Wernet G (2017) Critical review of elementary flow definitions in LCA data. INT J LIFE CYCLE ASS. https://doi.org/10.1007/s11367-017-1534-3 [3] ISO 14044 (2006) ISO 14044: Environmental management–Life cycle assessment—Requirements and guidelines. International Organization for Standardization, Switzerland

TU107
Building a Life Cycle Inventory of stormwater pollutant fluxes: model evaluation for a separate residential urban catchment
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TU108
Tissue specific 32P accumulation and consequent biological effects in bivalve molluscs
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1. Introduction
The aquatic environment is the natural habitat and recipients of anthropogenic pollution, including radioactive nuclides. Despite the growing concern over presence of radionuclides in the aquatic environment, there has been only limited studies to determine potential biological responses in aquatic invertebrates following exposure to environmentally realistic levels of radiation doses. This integrated study determines and compares tissue specific bioaccumulation, doses delivered and induced biological damage in two species of mussels, the freshwater species Dreissena polymorpha (DP) and marine Mytilus galloprovincialis (MG), following exposures to an important radionuclide, phosphorus-32 (32P).

2. Materials and methods
The study involved 10 days exposures of mussels to 32P of varying dose rates (i.e. 0.10, 1.0 and 10.0 mCi/dl) taking into account a current no-effect screening value of 0.24 mCi/dl (European Commission). The first set of studies determined 32P accumulation in specific mussel tissues (i.e. adductor muscle, digestive gland, mantle, gills and ‘other’). Internal mussel water (water inside the mantle cavity), shell and faecal matter using scintillation techniques. From this bioaccumulation study, we were able to highlight key tissues of interest; the digestive gland for example, received the greatest proportion of 32P independent of mussel species. In the next set of studies, a suite of biological responses of varying dose rates were investigated in digestive gland and gill cells. This included the induction of DNA damage ( Comet assay) and repair response (Gamma-HAX), the induction of micronuclei (MN) and the expression of key stress related genes (i.e. SOD, CAT, GST, HSP70/90).

3. Results and discussion
Our findings highlighted DNA damage and MN induction at radiation doses as low as in 0.1 mCi/dl in digestive gland (MN = also in gill) in both species, below the screening benchmark. Furthermore, compared to fresh water (DP) and marine bivalve (MG) displayed no DNA damage (both tissues) across all 32P treatments. This study highlights that (a) radionuclide activity concentrations in a biological system cannot be predicted by surrounding environmental media (b) with regards to bioaccumulation of waterborne contaminants, whole body measurements may mask the tissue specific nature of radionuclide uptake, and (c) the importance of adopting a multi-species, multi biomarker approach when assessing the possible effect of contaminants in the aquatic environment.

TU109
Endocrine disruption in Mytilus galloprovincialis: Is ethinylestradiol a vitellogenin inducer?
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Vitellogenin (Vtg), the egg-yolk precursor in female ovariou animals, is a common biomarker of estrogenicity widely used as an indicator of endocrine disruption in aquatic environments. Nevertheless, in the case of molluscs, it is still unclear if the synthesis of Vtg is regulated by steroid hormones as in the case of vertebrates. In the case of the synthetic hormone ethinylestradiol (EE2) the results of the studies are inconclusive. The aim of this work is to verify whether the synthesis of estrogen 17beta-estradiol (EE2) induces the production of Vtg in Mytilus galloprovincialis at two exposure times and different nutritional regimes. For that, we used a shotun label-free proteomics approach by high resolution LC-MS/MS to identify and quantify Vtg in mussel gonads. In this way, we can verify if the energetic balance is a key confounding factor in Vtg production. The relationship between the maturity state of mussels and their Vtg levels was studied as another possible confusing factor. Mussels from uncontaminated area in Galicia (Spain) were collected in autumn/winter, corresponding with early gametogenesis stage. Mussels were exposed during 4 and 24 days to 100 ng L−1 of EE2 to assess whether Vtg synthesis was induced by EE2. During exposure, mussels were fed three times per week with two different regimes: a low regime (equivalent to 0.29 % of mussel dry weight per day), or with a high regime (equivalent to 5.55 % of mussel dry weight per day), representing negative and positive energy balance respectively. For the low feeding regime, shotun proteomics identified an detected Vtg only in female gonads. The results showed an increase in Vtg levels in mussels exposed for 4 days to 100 ng L−1 of EE2 compared to the control solvent, although this increase was not statistically significant. In mussels exposed for 24 days to 100 ng L−1 EE2, Vtg levels were higher than in mussels exposed to a solvent control. These results suggest that EE2 does not induce Vtg in Mytilus galloprovincialis. However, it is possible that Vtg synthesis was impaired by the fact that organisms were in negative energy balance. The results of the experiments done at a higher feeding regime (currently being analysed) will confirm this result. A significant correlation was found between Vtg levels and the maturation state of female mussels, indicating that maturation state is a confounding factor for the application of Vtg levels in endocrine disruption studies.
Integrating natural processes in environmental hazard assessments of the oil sands

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The Athabasca oil sands deposits in northern Alberta, Canada are a naturally occurring mixture of bitumen, sand, clay and other minerals. Bitumen, which is a heavy and extremely viscous oil, is mined and then subsequently refined to produce gasoline, diesel and other hydrocarbon-based products. Moreover, the naturally occurring Athabasca Oil sands deposits are a source of both physical and chemical stressors to regional rivers that flow through the deposit. Physical stress on aquatic biota from natural bitumen results from hillslope erosion processes and slumping of material into the rivers, while chemical stress arises from bitumen-derived contaminants entering the waters. To fully understand the ecological and cumulative effects of oil sands mining activities on aquatic ecosystem water quality and associated biological structure and function, there is a need to evaluate the effects of naturally occurring bitumen in the aquatic environment. The main objective of this study was to evaluate the possible ecotoxicological effects associated with the slumping of river bank material (i.e. oil sands deposit that naturally enters the river systems through fluvial geomorphological processes). A series of inter-related laboratory ecotoxicological assays were conducted using both acute and sub-acute endpoints on the offspring and the population dynamics extracted from different sources in regional rivers (SP, ATB, STB and ELLs). All ecotoxicological results were complemented with the chemical analysis of metals, naphthenic acids (NAs) and polycyclic aromatic hydrocarbons (PAHs) to understand the possible effects that this material will induce when in contact with aquatic systems. All tested organisms responded positively to the presence of oil sands. Oil sands were lethal to the exposed to contaminated liquid media or through sediment contamination with solid oil sands material. A pattern of toxicity was also observed, where the SP source material was the less toxic and ELLs material being more toxic. These results corresponded with the chemical analysis which showed the ELLs sample having higher levels of PAHs and NAs. In summary, tests revealed that oil sands material affected model organisms under laboratory exposures, especially in samples with more NAs and PAHs content.

TU11
Genomic DNA methylation level : a stress molecular marker in the species Gammarus fossarum

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Genotoxic evaluation has been developing for a couple decade among ecotoxicological assessment approaches in the aquatic field. It offers some prospect for using short and delayed effects on the offspring and the population dynamics (provided genetic mutations affect gametic genome). However, the modification of the DNA sequence by genetic mutation (as a result of primary DNA damage) is not the only impact of toxic substances on the genome. For example, epigenetic effects, defined as heredity effects on the DNA function, may add up to mediated effects by genetics way. Among these marks, DNA methylation is extremely studied by scientists. As such, it is important to examine epigenetic changes in the context of population level perspective. This provides a complementary approach to effects on the primary structure of the genome for taking into account the time interval between the exposure to environmental contaminants and their effects. This issue is a real challenge in ecotoxicology. Moreover, epigenetic allows improving the understanding of changes of life history traits (reproduction, growth and development). These parameters are suitable for assessing the toxicity and are known to be regulated by epigenetic. Finally, epigenetic could also help better understand the variability of effects related to experimental conditions between the studies. Therefore, epigenetic marks have an innovative nature for the evaluation of environmental risks. In this regard, we have investigated the measurement of genomic DNA methylation level as a stress molecular marker in two ecologically relevant species Gammarus fossarum. First, the basal level was explored by studying the difference of overall DNA methylation between male, female and juvenile. Then, we evaluated the effects of natural factors on genomic DNA methylation level as starvation and exposed to different temperatures (8, 12 and 18°C) for 7 days and 1 month. To know the variability of DNA methylation in populations of Gammarus fossarum, three French populations from the same genetic strain, were studied. Lastly, the epigenetic biomarker response to a chemical stress was evaluated in a field experiment. We encaged gammarids from a reference unpolluted station and then sampled them as a way to understand the natural variability of effect of the exposure scenarios. However, metabolomics is an emerging field and to interpret the use of metabolite data for the understanding of toxicological responses is challenging. We need to know what is ‘normal’. The variability in individual metabolomes for a species, or a ‘background metabolome’ should be established to determine possible confounding factors such as age, sex and moulting (among others) that may influence data interpretation. Thus, we have characterised the effect of these factors on the metabolite variability in the freshwater invertebrate, G. pulex. Herein, an analytical method is proposed for the extraction and non-target analysis of the metabolome in G. pulex. Briefly, a dual phase liquid extraction was used followed by HILIC-HRMS to enable detection and annotation of metabolic features extracted from individual animals. Animals collected from the field were analysed immediately and compared to animals that were extracted after a fixed period of acclimatisation to laboratory conditions. The results indicated that sex, moulting stage and acclimatisation period affected the metabolite variability and factors that are likely to influence metabolomic analyses should be investigated to aid understanding of pathways involved in effect-based studies. Furthermore, it may be possible to develop a species-specific and moulting stage-related metabolomic profile that may be used as a biomarker of environmental change.

TU13
Ecotoxicological effects of the insecticide Imidacloprid on amphipods along pollution gradient in a river

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Many aquatic organisms are sensitive to man-made chemicals in the water. However, some species tolerate the occurrence of toxic chemicals and at the same time benefit from the nutrients that are often abundant in polluted waters. Such is also an amphipod species Gammarus pulex (Crustacea, amphipoda), which can be found throughout a pollution gradient of a stream. In our research, we investigated whether G. pulex individuals have an ability to adapt to the pollution gradient and to survive likewise in pristine and in polluted sites or whether different conditions select for different phenotypes within the population. G. pulex individuals were sampled at different sites along a pollution gradient in the river Holtenmeer (Netherlands - Atlantic coast). Gammarids were characterized with respect to pollution burdens of water and amphipod tissues. Amphipods from three sampling points were brought alive to the lab and exposed to the insecticide Imidacloprid, which was found in water and animal samples beforehand. Lethal time for 50 % (LT50) values were determined and movement activities and moulting rates were recorded. Mortalities in the Imidacloprid treatments clearly differed for amphipods sampled at different sites; animals from more polluted sites were more sensitive to the toxicant and also exhibited reduced movement and moulting activities. We examined whether these differences in toxic sensitivities were related to differences in toxicokinetics of Imidacloprid by quantifying imidacloprid tissue levels after different times of exposure to the compound but toxicokinetics of imidacloprid proceeded similarly in animals from different sites. Population genetics approaches (sequence comparisons of a DNA stretch of the cyctochrome oxdase I (COI) gene and comparisons of 9 microsatellit loci) revealed that differences in conditions between sites did not lead to the separation of distinct subpopulations suggesting that survival of individuals at each site is based on individual acclimation and not on adaptation to specific conditions by a distinct subpopulation.

TU14
Antenne Regeneration of the Marine Amphipod Parhyale hawaiensis as a Possible Endpoint in Ecotoxicology - Preliminary Data

O. Diehl, P. Assano, G. Umbuzeiro, School of Technology, UNICAMP / LAEG Parhyale hawaiensis is a marine amphipod of worldwide circumtropical distribution. An ecotoxicological tests for Parhyale hawaiensis is able to regenerate its appendages, limbs and tissues after an injury or lost during the entire course of their life. Regeneration can be used as an ecotoxicological endpoint to assess potential teratogenic compounds and their impact on stem cells. Studies suggest that P. hawaiensis has local progenitor cell in each part of body. It was already been demonstrated that P. hawaiensis has a fast regeneration of thoracic limbs, within a week, but no information on antennae’s regeneration was found. Thus, the aim of this study was to obtain data on regeneration of antennae of P. hawaiensis to determine the viability this endpoint on toxicity tests. On day one left antennae of six months old organisms were amputated with sterilized tweezers, each
organism transferred to recipients containing 100 mL salt water and a picture of each of these organisms was taken under a stereomicroscope. Each test consisted of 20 organisms, 10 males and 10 females. During this period, organisms were fed three times a week, the necessary conditions of salinity, temperature, aeration, substrate, and luminosity were provided. Four independent experiments were performed. The organisms were monitored daily until all of them undertaken full regeneration. At the end of the experiment, another pictorial record was done to determine the difference between the male and female length (mm) before and after full regeneration. As a result of this occurrence from 7 to 20 days (n=80) after amputation and males and females behaved differently, as males took more time than females to complete regeneration. Length of the regenerated antennae varied from 50 to 80% of the original appendages to both male and female. Next steps will be the exposure of organisms to selected toxicants to investigate their absorption process in the described experimental conditions.


TU115 Added value of community approaches in environmental risk assessment

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Community studies are an ecologically relevant tool to assess effects of stressors on population and community level. With these kinds of studies direct as well as indirect effects on aquatic macro- and micro-invertebrate species can be assessed. Furthermore, community studies like aquatic mesocosms, terrestrial model ecosystems (TME) or field studies, a variety of non-standard species interacting with each other and their abiotic environment are included and can be evaluated. Aquatic mesocosm studies have been used as higher tier tool in risk assessment of plant protection products in the EU since the 1990ies. In the last decades they have been developed to be able to assess effects of non-standard species that cannot be covered by the current higher tier studies. However, community tests were often criticised for their high variability and low statistical power. In the last decades, sampling methods have been optimized and a pragmatic approach for MDD categorization has been developed to evaluate effects with regard to their statistical power. Furthermore, in the last years there is an increasing concern that current risk assessment is related to a single product while in the environment the populations are exposed to a multitude of different plant protection products. In principle, in those community test systems also multiple mixtures or typical scenarios of products can be tested. Due to the characteristic of the cur-rent risk assessment procedure sequences of different products are not yet considered. In conclusion, community studies are often noticed only as tools to defend single plant protection products without recognizing their outstanding ecological value. These studies are still the most realistic approach to assess effects on population and community level under realistic environmental conditions. The position and the order of these highly informative studies in risk assessment should be rethought. We suggest further options to integrate community approaches in risk assessment. These options are the temporal assessment of these systems in order to get a broader idea about the relevant effects on ecosystem structure and function; 2) as monitoring tool for products which passed risk assessment to check up on community level effects; 3) as monitoring tool for typical sequence scenarios of different products which will be used together in one crop. Here exemplary results of community studies and a screening study will be presented.

TU116 Metal pollution and macro-invertebrate communities in the Olifants River, Western Cape, South Africa

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Freshwater ecosystems are considered among the most threatened, as a result of current trends in water utilization globally. Within the Western Cape, 76% of rivers are polluted and run the risk of irreversibly losing their ability to support invertebrate and fish communities. In South Africa, SASS5 (South African Scoring System for Invertebrates) is a river health index that studies the invertebrate assemblages within specific riverine microhabitats, and can assist in shaping the relationship between water quality and species richness in freshwater ecosystems. The Olifants River in the Western Cape, is not only recognized as a hotspot for freshwater biodiversity, but seen by many, until the previous decade, to be the last pristine river along the South African coastline. It is also one of the three main feeding rivers to the City of Cape Town for fresh water. Despite increasing urbanisation, the last State-of-Rivers Report for this river was published in 2006. It has therefore become crucial to investigate the current degree of pollution within this river, as well as the general integrity of the system. This study aimed to determine the degree of metal pollution along the length of the Olifants River, as well as to investigate the effects of pollution and land use on the invertebrate communities, using SASS5. Water and sediment samples were collected seasonally at 5 sites from upper to lower reaches, acid digested and analysed with an ICP-AES for metal concentrations. Invertebrates were also sampled seasonally, identified and scored according to SASS5 sensitivity scores. An Average Score Per Taxon (ASPT) was calculated for each site. The results showed a general trend of increasing sediment metal concentrations, land use practices and habitat alterations, with concomitant decreasing ASPT’s, from site 1 to site 5, indicating a loss of certain sensitive species at the most impacted downstream sites. Although metal pollution was found to be relatively low, a cocktail of pollutants, coupled with structural alterations, are clearly impacting the health and integrity of this river system. A future study should focus on organic pollutants, as agriculture is one of the main land use practices in the area.

TU117 QWATER - Bioassay integration under the European Water Framework Directive?: A step towards an ecological approach

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The Water Framework Directive (WFD) is the most important piece of water legislation in Europe. It aims at ensuring the ‘good water status’ of EU water bodies and includes both chemical and ecological status. To achieve and assess a ‘good ecological status’, the WFD advocates the integration of various lines of evidence, and demands a set of low-cost tools and techniques to deliver appropriate data. The WFD accounts for chemical, ecological and physical evaluation requirements regarding the establishment of cause-effect relationships in the assessment of environmental quality. Under this approach, the European Marie Curie QWATER project was aimed to gauge the ecological relevance of integrating short-term toxicity bioassays and biomarkers into quality elements in the WFD, as these may contribute to our ability to assess and manage EU water bodies. Ecologically relevant in situ cost-effective toxicity bioassays were used in a battery of in situ bioassays using representative species for several key functions in the ecosystem. Biomarkers, determined on the individuals used for the bioassays, were also integrated. Principal component analyses (PCA) were performed independently for each source of information, in order to improve the interpretation of the resultant PCA-factors in biological terms, and to verify whether the integration of ‘quality elements’ (bioassays and biomarkers) did (or did not) strengthen the robustness of the standard Ecological Quality Status approach used to assess water quality. Results shown some discrepancies in the water quality determined from each independent factor, i.e., the sampling sites were not equally ordered by all factors. Therefore, only by interpreting the values of all PCA-factors together, the WFD results can be introduced as new feasible, cost-effective and sensitive protocols in the WFD. It might then become pertinent to stand for the combined/complementary use of ecological indicators, biomarkers, and conventional chemical and physical parameters to assess EU water bodies. Overall, this project allowed us to efficiently contribute to national and international efforts focused in evaluating the water quality in European water bodies.
Before test start. In a first step the test conditions were adapted to the requirements of mayfly larvae. Therefore testing of different media was performed. It turned out that, contrary to testing of snailly larvae, which is performed in Cu-reduced dilution water, moderately hard reconstituted water (according to EPA) works best for testing of mayfly larvae. Instead of Tetramin®, which was used in stonefly testing, the green algae Desmodesmus subspicatus was used for feeding of mayfly larvae. As a result, all tests with stonefly larvae were acclimated for 48 hours, the acclimation period was extended to seven days before test start. Under these conditions mayfly larvae showed an acceptable mortality of test organisms. The next step is to perform a test with the test substance Imidacloprid which will be exposed to mayfly larvae for 21 days. Afterwards sensitivity of mayfly and stonefly larvae to Imidacloprid will be compared. The new testing method can provide toxicity data of aquatic tests of different aquatic invertebrates, which can be used for a SSD (Species Sensitivity Distribution) approach. The developed test system, the results of the performed tests as well as a comparison between testing of mayfly and stonefly species will be presented.

TU119 Toxic effects of a carbamate insecticide on a non-target freshwater gastropod: active ingredient versus commercial formulation

Carbamate insecticides are commonly used in agriculture for crop protection exerting their toxicity through the inhibition of the enzyme acetylcholinesterase. In Argentina, the maximum concentration of carbaryl (CAR) detected in surface and subsurface drainagages was 45.7 µg L⁻¹. In this study, we evaluated the subchronic toxicity of environmental concentrations of the active compound and a commercial formulation of CAR on biochemical and reproductive parameters in Biomphalaria straminea, a freshwater gastropod native to Argentina. Five treatments were included in this study: dechlorinated tap water, acetone in dechlorinated tap water (solvent control), CAR active compound (dissolved in acetone) in dechlorinated tap water at 12.68 and 12.68 mg L⁻¹, and the equivalent to 12.68 mg L⁻¹ CAR of a formulation (dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were chosen so as to have the same molarity as previously used. The responses evaluated were: the concentration of CAR and its metabolites in the test system, the results of the performed tests as well as a comparison between testing of mayfly and stonefly species will be presented.

TU120 Toxicity of lanthanides to freshwater microcrustaceans

The application of lanthanides (La) in different sectors of the world economy has significantly increased during the last two decades. This process has been accompanied by concerns about the environmental impact of these elements. The anthropogenic anomalies of Ln in soil, surface water, groundwater and even in tap water have already been registered. The disruption of the natural biogeochemical cycle of Ln increases the risk of biota being exposed to elevated concentrations of Ln. However, the ecotoxicological effects of these elements and their fate in the environment are still insufficiently understood. The toxic concentrations reported in the literature, e.g., for Daphnia magna, notably vary presumably due to different test conditions. For this study, acute ecotoxicity testing of La, Ce, Pr, Nd and Gd nitrates to freshwater crustaceans Daphnia magna (48 h) and Thamnocephalus platyurus (24 h) were performed in synthetic freshwater and natural lake water.
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V. van der Schyff

Activities were 13.2 ± 0.3 and 52.3 ± 1.1 nmol min\(^{-1}\) across substrates. Focusing only on AChE activity in C. riparius, Daphnia magna, and other esterases are important in terms of assessing the toxic mechanism of organophosphate and carbamate insecticides. There are several techniques for measuring AChE and general esterases (GE) activity involving spectrophotometric or fluorescence detection of transformation products. In this study, we tested four methods to detect AChE and GE activity in vitro and in vivo in the two aquatic invertebrate species: Daphnia magna and C. riparius. The aim of this comparison was to evaluate the efficiency and selectivity of the four methods. 2) To compare in vitro with in vivo measurements and 3) to compare the inherent esterase activities of D. magna and C. riparius. The four assays were: 1) AChE assay using acetylthiocholine iodide (ATCI) as substrate, 5,5'-dithio-bis-(2-nitrobenzoic acid) (DTNB) as chromogen, measuring the production of 5-thio-2-nitrobenzoic acid; 2) AChE assay using acetylthiocholine iodide (ATCI) as substrate, measuring resorufin production; 3) GE assay using 1-naphthyl acetate (1-NA) as the substrate, measuring 1-naphthol production and 4) GE assay using 4-methylumbelliferyl butyrate (4-MUB) as the substrate, measuring 4-methylumbelliferone production. Michaelis-Menton curves were created for all substrates, where it was possible. The results showed that the GE assay using 4-MUB measured general esterase activities well both in vitro and in vivo in D. magna and C. riparius. However, the AChE assay using ATCI was found to be only useful in vitro, while the AChE assay using resorufin formation could not be used either in vitro or in vivo. The maximal GE activities in vitro in D. magna and C. riparius were 345 ± 44 and 151 ± 51 nmol min\(^{-1}\) protein, respectively, when using 1-NA and 295 ± 8 and 60 ± 13 when using 4-MUB, hence, showing comparable activities across substrates. Focusing only on AChE activity in vitro the maximal activities were 13.2 ± 0.3 and 52.3 ± 1.1 nmol min\(^{-1}\) protein in D. magna and C. riparius, respectively, making C. riparius the species with the highest activity. Turning to in vivo measurements, the GE activities were 49.1 and 17.4 nmol min\(^{-1}\) protein for D. magna and C. riparius. The results of GE assays using 1-NA and 4-MUB are similar. The AChE assay could not be conducted in vivo. The GE assay using 4-MUB, however, could be conducted in vitro as well as in vivo. The GE activity in D. magna was higher while the AChE activity in D. magna was lower compared to C. riparius.

TURBO2

Factors influencing bioaccumulation of metals and pollutants in corals
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Tetrachloroethylene (TCE) is a contaminant frequently found in groundwater of industrialized areas worldwide. The degradation of this chlorinated aliphatic hydrocarbon (CAH) is often incomplete in groundwater and takes several decades. Contamination from TCE is considered persistent and difficult to remediate, due to its high density that favors a gravity-driven vertical infiltration into groundwater bodies. Through means of the Water Framework Directive the European Union has demanded Member States to provide TCE threshold values (TV) for assessing groundwater body quality. In Italy, TCE TV is 1.1 μg/L in groundwater bodies. Studies on surface water species have shown that TCE causes oxidative stress in different organisms, however the effect of this contaminant on groundwater-oblige species has not been investigated to date. More importantly the effect that 1.1 μg/L TCE may have on groundwater species under chronic exposures is unknown. In this study, we investigated the effect of 1.1 μg/L TCE on survival, oxygen consumption, and locomotory activities of a groundwater-oblige copepod species (Moraria sp.) under different time exposures. The specimens required for the trials were collected in the Antro del Corchia Cave (Tuscany). We measured the individual-based oxygen consumption of this species as a proxy of possible metabolic reactions to long-term (≥ 4 days) exposures to TCE at 8.0°C, i.e. about the mean annual temperature of groundwater in the cave. To this end, we used a sealed glass microplate equipped with planar oxygen sensor spots with optical isolation glued onto the bottom of 80-μL wells (LoLoğ, Warsaw, Poland) and a microplate reader (Sensor Dish Reader, PreSens, Germany). The system allows simultaneous measurement of 4 replicates and 4 controls. Survival and locomotory activity assessments were performed by counting the number of alive individuals and measuring the number of moving animals in 5 mL glass vials each containing 20 individuals.

TU117

MOLECULAR AND BIOCHEMICAL BIOTRANSFORMATION RESPONSES IN OYSTERS Crassostrea brasiliana (Lamarck, 1819) EXPOSED TO PYRENE AND FLUORENE
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Polycyclic aromatic hydrocarbons (PAHs) constitute a class of widely distributed organic pollutants in aquatic environments. PAHs affect organisms due to its carcinogenic, mutagenic and/or teratogenic characteristics. Once the PAHs enter...
the cell, they require a multistep metabolic activation by specific enzymes that participate in biotransformation reactions. The aim of this study was to evaluate biochemical and molecular biotransformation responses of the oyster *Crassostrea brasiliana* exposed to pyrene (50 mg/L and 100 mg/L) and fluorene (100 mg/L and 200 mg/L), after two time periods of exposure (24 h and 96 h). The half-life times of both PAHs were quantified by fluorescence in the aquaria exposure water and the transcription of phase I (CYP1-like, CYP2-like, CYP2A1U1 and CYP156A1-like) and phase II (GST-like, GSTm-like and SULT-like) biotransformation genes, EROD, GST and GSTM activity, were evaluated in gills. The half-life time of pyrene (100 mg/L = 2 h and 12 min) was lower than fluorene (100 mg/L = 5 h and 54 min). These results might be related to the higher lipophilicity of pyrene, facilitating its influx through the plasma membrane into the intracellular medium, whereas fluorene exposure, transcript levels of phase I and II biotransformation genes and enzymes in pyrene metabolism. This study contributed to the identification of new biomarkers of PAHs contamination in *C. brasiliana*. Also evidences a possible participation of these genes and enzymes in pyrene biotransformation metabolism. In addition, it suggests the participation of CYP2A1U1 gene in the biotransformation process of PAHs in gills of *C. brasiliana*.

**TU128 BIOCHEMICAL AND CELLULAR RESPONSES OF THE CRAB *PACHYGRUS MARMORATUS* TO EVALUATE THE ENVIRONMENTAL CONTAMINATION OF THE LIVORNO HARBOR (ITALY) AND OF AN ADJACENT MPA**

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The main purpose of the present investigation was to assess the toxicological status of Livorno harbor in Italy and of an adjacent MPA, through the responses of a set of biomarkers in the crab *Pachygrus marmoratus*. This investigation is part of the IMPACT project (Port Impact on Marine Protected Area: cross-border co-operative actions), which has the purpose to design cross-borders management plans to actually protect the Marine Protected Areas. Male and female crabs were collected from the different areas: Livorno harbor, considered a polluted area, and the marine protected area, considered a less contaminated area. The study was held in the Livorno harbor, where we intended to explore the potential adverse effects of port contamination. A battery of biomarkers was employed to assess neurotoxic effects (acetylcholinesterase, AChE activity), energy metabolism (isocitrate dehydrogenase, IDH; lactate dehydrogenase, LDH), oxidative stress (lipid peroxidation, LPO; glutathione S-transferase, GST; glutathione peroxidase, GPX; glutathione reductase, GR; catalase, CAT; glutathione, GSH) and DNA damage (erythrocyte nuclear abnormalities, ENA assay) in the crabs. The levels of trace elements and PAHs were also evaluated in the sampled specimens. Results showed that the crabs sampled at Livorno harbor are exposed to contaminants able to cause oxidative stress and genotoxic effects. LPO and ENA assay showed a statistically significant difference between specimens collected at Livorno harbor and the samples coming from the MPA. The average values of LPO were about three times higher in crabs sampled in Livorno harbor in comparison with that sampled in the MPA. The results trends are not influenced by the sex and the female showed higher values of biomarkers in comparison with the males. The crab *P. marmoratus*, used for the first time as a bioindicator to investigate the toxicological status of a port and an MPA area by the use of a multi biomarker approach, was found to be a good sentinel species to monitoring coastal marine environment.

**TU129 Toxicity of titanium on the mussel *Mytilus galloprovincialis***

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Titanium (Ti) is at forefront of research related to nanomaterials. Due to their physical and chemical properties, Thin nanoparticle (TiO$_2$) are widely used in aquatic environment, which interact with the surrounding water components and food colorants, toothpastes, solar cells, sunscreens, cosmetics and boat paints. With the increasing production and use of TiO$_2$, it has been inevitably released into aquatic systems through wastewater treatment plants, surface run-off, direct inputs and atmospheric deposition. The increasing input of TiO$_2$ in the aquatic environment has raised concerns about the toxicity of Ti to inhabiting organisms. Once in the aquatic environment TiO$_2$ interacts with the surrounding water components, including other contaminants, which may change the availability of Ti to organisms, namely the ability to penetrate into cells which may result in toxicity. In the present study the mussel species *Mytilus galloprovincialis* was used to evaluate the impacts caused by the exposure of Ti (II) solutions with the initial concentrations of 5g/L, 50g/L, 100 g/L of Ti (II). Biochemical (oxidative stress related biomarkers, metabolic capacity and energy reserves) markers, after 96 hours and 14 days exposure periods, were evaluated. The obtained results revealed significant alterations in contaminated mussels, varying with the concentration and time of exposure. Mussels exposed to Ti presented lower metabolism, represented by lower electron transport system (ETS) activity, which decreased along exposure until decreased to their glycan (GLY) and protein (PROT) contents. Moreover, contaminated individuals activated their antioxidant defenses increasing the activity of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione S-transferases (GSTs), which still were not enough to prevent cellular damages (revealed by the increase of lipid peroxidation in mussels exposed to Ti).

**TU130 Comparing interspecific Artemia responses to chronic zinc exposure**

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The invasive species *Artemia franciscana* is displacing native *Artemia (A. salina and A. parthenogenetica)* from eastern Atlantic coasts and across the Mediterranean region. Apart from the eutrophication, polyculture of *Artemia* demonstrates the importance of assessing the impacts of *Artemia* on marine environments. For this purpose, this study assesses the sublethal and lethal effects of zinc (Zn) exposure on Artemia franciscana in contaminated areas and compares the results with those obtained in uncontaminated areas. *Artemia franciscana* from different sampling sites were used in this study (La Torre, Murcia; Collolao, Vigo; Estrecho, Algeciras; Livorno, Italy) to ensure that the results obtained were not site-specific. A. franciscana specimens were exposed to three different Zn concentrations (0.25 mg/L, 0.5 mg/L and 1 mg/L) for 14 days in order to determine the effects of Zn exposure on *A. franciscana* survival, growth and reproduction. A wide range of endpoints (higher survival and growth) than *A. franciscana* from uncontaminated areas. The Zn concentration used in our experiments (0.25 mg/L) was the double of that recorded in water from the Odiel saltpans to make our results as relevant as possible to real field conditions. Cysts were hatched in seawater and nauplii (A. parthenogenetica) or separated in couples (A. franciscana) according to their groups (control and treatment) and a set of reproductive parameters were examined. Results showed that *A. franciscana* performs better (higher survival and growth) than *A. parthenogenetica*. Both species experienced significant slower growth and higher mortality when exposed to Zn, but not significant effects were found in final size. Regarding reproductive parameters, Zn exposure increased offspring production of both Artemia species when compared to control groups of the same species. However, native *A. franciscana* showed a higher number (number of broods and offspring production; lower % non-viable nauplii) than *A. franciscana*. The results of this work highlight competitive advantages of native species (A. parthenogenetica) from contaminated areas to prevail under the selective pressure of abiotic factors as environmental pollution. Based on these results the highly polluted Odiel estuary would not be a refuge for native *Artemia* species, as suggested by the theory of local adaptation. **Keywords**: Artemia species; Local adaptation; Sublethal exposure; Zinc contamination.

**TU131 Promising invertebrate species as model organism in ecotoxicology: ephrurid cladofleas of the jellyfish Aurelia sp. and Sanderia malyanesis**

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In aquatic toxicology, one of the most important steps is the selection of suitable model organisms, able to provide information on the acute and chronic toxicity of marine pollutants. In this context, invertebrates species are being used extensively in laboratory tests for their usefulness for seeking mechanistic links between effects occurring at the individual level and consequences for higher levels of biological organization. In addition, compared to vertebrates they are also easy to maintain under laboratory conditions, widely distributed and ecologically relevant. Although Cnidarian jellyfish (Scyphozoa) are known to play an important role in marine systems, they are not yet employed in routine ecotoxicology. The aim of this current investigation is to suggest the use of two new invertebrate species of the jellyfish *Aurelia sp.* and *Sanderia malyanesis* as model organisms in ecotoxicological biosays. A series of experiments were carried out in laboratory controlled conditions, in order to characterize some experimental parameters that can influence the Frequency of sub-lethal endpoints and behavioral endpoints in *Aurelia sp.* and *Sanderia malyanesis*. This study focuses on the sub-lethal response for this innovative invertebrate model for ecotoxicological testing. After these preliminary tests, ephyrae were exposed to a wide range of potentially toxic compounds (metals, surfactants, pesticides, nano-materials and harmful algae, emerging compounds), in order to evaluate the potential of ephyrae jellyfish in ecotoxicology. The experiments allowed to identify two end-points (sub-lethal, frequency of pulsatia and acute, immobilization) with different levels of sensitivity and to optimize the use of an automatic recording system of swimming marine invertebrates (Swimming Behavioural Recorded e SBR), already employed with other biological models. In addition, the comparison of the EC$_50$
values obtained exposing ephyrae jellyfish to different toxic compounds and materials such as nanoparticles and microplastics with those obtained with other marine invertebrates, highlights that ephyrae are an interesting and promising invertebrate model with a very high ecological relevance to be used in ecotoxicological investigations.

TU132 Paracentrotus lividus and Artemia sp.: never too old model organisms to give new end-points

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In the last few years it has become increasingly important the contribution of ecotoxicological assays to the environmental monitoring, as a fundamental instrument of chemical analyses. In environmental risk assessment, in order to fulfill several regulatory requirements, such as the 3R principles (reduction, refinement and replacement), the development of novel approaches to reduce and eventually substitute the use of vertebrate species results to be paramount.

Swimming alteration is one of the most frequently used behavioral responses in aquatic ecotoxicology and its evaluation has proved to be a valuable endpoint in ecotoxicological studies with aquatic organisms. Behavioral responses have proven their usefulness in evidencing impacts of chemicals at environmental concentration that do not necessarily cause mortality; therefore, behavioral endpoints are less invasive than traditional acute tests, but still sensitive and more ecological relevant. In this work, we reported a novel research on the use of swimming behavior of two “old” marine model invertebrates in ecotoxicology, the crinoidae Artemia sp. and the echinoderm Paracentrotus lividus. As both display swimming behaviors as distinct endpoints. In detail, we optimized and improved an automatic recording system, namely Swimming Behavioral Recorder system (SBR), by developing i) a new swimming speed alteration test used for the first time sea urchin early stages; ii) a new short-term test based on the evaluation of the swimming speed alteration of Artemia nauplii incubated at 39 °C (±1) for only 6 hours. Thanks to a modern video-based technology, this study provides novel perspectives and future applications applied to two well-known marine model invertebrates, meeting regulatory and market demands, including the reduction in using vertebrate species and the need for early warning technologies.

TU133 Application of sea-urchin embryo test in the effect directed analysis approach for the evaluation of WWTP effluent in an estuarine media

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Since target chemical analysis often cannot explain the cause-effect relationship between certain contaminants and the observed effects in organisms, effect directed analysis (EDA) can be applied to unravel the drivers of toxicity in complex mixtures. In this study, the sea-urchin embryo test (SET) was implemented for the first time in a EDA approach in order to evaluate an estuarine environment influenced by the effluent of the main waste-water treatment plant (WWTP) of Bilbao (Bilbao WWTP). This was extracted by sequential LC-UV fractionation methodology based on two different columns: a Nucleosil C8 column (21 fractions were collected) and an aminopropyl column (15 fractions). Two endpoints were used to detect the toxic effects after 48 h: the growth rate of the larvae and the rate of skeletal malformation. 6 levels (n=3) of dose-curve were prepared in units of relative enrichment factor (REF, final volume of 3 mL of filtered seawater with 0.1 % of DMSO). Non-dose curve were prepared in units of relative enrichment factor (REF, final volume of 3 mL of filtered seawater with 0.1 % of DMSO). Non-target analysis was performed by means of UHPLC-Qactive Plus MS in positive and negative modes with a C18 column. Toxic compounds were identified using MS2 spectrums, Metfrag and Compound Discoverer (Thermo) interfaced to MZmine. Among the collected C8 fractions, only fraction 13(2) (F13) showed a clear toxicity and, therefore, it was tested separately to establish the concentration-response model. The curve-dose response of the raw sample (EC50 = 10 REF and EC90 =19 REF) could be explained by the contribution of active F13 (EC50=14 REF and EC90=39 REF). Regarding the chemical analysis, among the final candidate list (20 compounds, mebandazole (an antihelmintic agent) was confirmed chromatographically with standards. Nevertheless, a sequential fractionation of F13 was also carried out with an aminopropyl column, which showed a different orthogonality compared to C8 column, and the resulting 15 fractions were also submitted for further bioassays and data-dependent analysis. Overall, the results of this work suggest the possibility of addressing a kind of specific toxicity in sea-urchin embryos owing to the determination of only one toxic fraction and the contaminants identified in that fraction. Acknowledgement. This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. L. Mijangos is grateful to the Basque Government and H. Ziarrusta to the Spanish Ministry for their predoctoral fellowships.

TU134 Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity

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Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxygenase pathway. As signaling molecules, they are important for diverse physiological systems such as inflammation, allergy, pregnancy, pain perception and blood pressure control. Therefore, they could be the important target for toxicant or drugs such as ibuprofen and aspirin. However, invertebrate model to evaluate eicosanoid pathway related toxicity has not yet been developed well though similar eicosanoid pathway was expected in invertebrate species. Therefore, the purpose of this study was to identify genetic information of key genes of eicosanoid pathway in Daphnia magna, a widely used invertebrate model, and to evaluate the transcription levels of the genes after the exposure to eicosanoid targeted drugs. To this end, we collected amino acid sequences of eicosanoids from other species and then compared the sequences in winter flea genome database. After the BLAST and alignment, the genetic information of 10 key eicosanoid genes, such as placa, cox, pgd2a and pge2, was identified. After that, Daphnia magna was exposed to the eicosanoid pathway targeted drugs, i.e., ibuprofen, indomethacin, celecoxib and acetaminophen at 0.25, 2.5 and 25 μM. Then, we analyzed transcriptome. To ensure orthogonality, we performed a chronic transcription of pgd2a gene was commonly down-regulated by all the eicosanoid targeted drugs. Interestingly, some genes, such as pgd2 and gdx1, were responded to certain specific drugs, celecoxib and ibuprofen, respectively. Through this study, we found that the nine of ten genes were expressed by exposure to the eicosanoid targeted drugs in D. magna. We believe that these results partially indicate the plausibility of D. magna model to evaluate the eicosanoid pathway related toxicity synthesis pathway. Also, the genes expressed in this study could be used as suitable biomarkers for the eicosanoid related toxicity assessment.

TU135 Responses to single chemical and pulse exposures of two monophyletic Daphnia species under a multi-generation approach

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Placocheta human activities such as agriculture and environmental contamination (e.g. industries, agriculture). Those contaminants may have continuous or pulse sources and can affect organisms from natural habitats. In different latitudes even phylogenetically close related species may present divergent chemical tolerance. Therefore, it was used in this study the model species from temperate areas Daphnia magna and the tropical species Daphnia similis. Most studies rely on short term acute and chronic tests. To ensure orthogonality, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under different dietary exposures (regular and restricted) and, regarding chemical mixtures of natural environments, pulse exposures (on Pb acclimated daphnids) to the fungicide mancozeb were also accomplished. Organisms from Pb were changed to a clean media for recovery for three generations. To monitor acclimation, standard acute immobilization tests to K2Cr2O7 (to check for sensitivity), to the metal Pb and to mancozeb were made. Since size is crucial on organisms’ ‘neonates’ body length was also measured. No difference on daphnids sensitivity was spotted among generations, except D. similis from recovery period under food restriction. However, Pb tolerance increase is seen on both species. Regarding mancozeb exposure (Pb acclimated), no difference between treatments is seen under regular food. However, opposite outcomes are shown under food restriction, such as D. magna increasing and D. similis decreasing tolerance to mancozeb. Adverse outcomes regarding recovery was shown, D. magna relied on genetic adaptation, since it kept a higher tolerance to Pb, even after three generations under recovery, and D. similis relied on physiological acclimation, being similar to organisms from control treatment. Food restriction also decreased reproduction and increased neonates’ body length (both species). The opposite outcomes under food restriction is crucial regarding natural environments and the natural fluctuating amount of nutrients. Therefore, results indicate that daphnids are capable of acquiring resistance to Pb under a long-term exposure, being an essential data on chemical mixtures contaminated habitats, since their tolerance to other chemicals can be lower (as shown for BaP). And also, opposite outcomes regarding monophyletic species indicates that it is not accurate use species from different climates to estimate toxicity.

TU136 Chronic effects of BPA, BPS, and BPSip in Daphnia magna

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Since bisphenol A (BPA) can act as a weak estrogen agonist and disrupt steroidogenesis, concerns on adverse health effects are increasing. In response to the regulatory pressures to eliminate BPA in plastics, bisphenol S (BPS) and
4-hydroxyphenyl 4-isopropoxysulfone (BPSIP) have been frequently used in manufacture of thermal paper and plastic containers. However, there is paucity of information on their chronic toxicity using aquatic invertebrates. In the present study, chronic toxicity of BPA, BPS, and BPSIP were evaluated using Daphnia magna in accordance with OECD Test Guideline 211. The endpoints for the long-term exposure were survival, reproduction, and growth. Compared to the control group, the body length was significantly decreased in D. magna exposed to 1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (<0.05). The results showed that BPA, BPS, and BPSIP could induce endocrine disruption related to the growth in aquatic invertebrates, and the effective concentration of BPSIP was similar to that of BPA. With increasing use of these alternative compounds, more monitoring program in aquatic environment and study of toxicity mechanism appear to be necessary. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-2015R1D1A1A01056628).

TU137 Oxidative effects of mono-(2-ethylhexyl)-phthalate on Daphnia magna in both molecular and population level
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Mono-(2-ethylhexyl)-phthalate (MEHP) is the metabolite of di-(2-ethylhexyl)-phthalate (DEHP), which is widely used in the industry as plasticizers. According to previous studies, DEHP inhibits molting hormone. In addition, MEHP is highly persistent and bioaccumulative in environment and living organisms. In EU Regulation 2004/2008 on the phasing out of MEHP acts as a specific disrupting chemical in aquatic organism such as Daphnia Magna. The aim of this study was to elucidate the linkages between toxicity test result and oxidative stress of MEHP. We studied the effects of oxidative stress as molecular initiating events on Daphnia magna. We observed the changes in different levels of the lipid peroxidation, glutathione S-transferases (GSTs), catalase (CAT) and superoxide dismutase (SOD) in the treated daphnids. This study showed the molting rate, reproduction rate and growth of daphnids during chronic (21 d) test in order to link the activities of reproduction system to antioxidant responses. Further study is needed to clarify how MEHP leads to dysfunction of endocrine system of Daphnia magna.

TU138 Are Daphnia magna and Chironomus riparius acute responses comparable?
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Laboratory ecotoxicity test results predict the responses of organisms with varying degrees of accuracy. Traditionally, the acute toxicity on aquatic invertebrates is estimated by exposing for 48 hours young cladocerans of Daphnia magna (OECD test guideline n. 202, 2004), taking advantage of its well-experienced sensitivity and reliability for a huge number of known and unknown toxicants. The 48 hours test on Daphnia magna conducted according to OECD 202 is listed as a data sufficiency reference in the EU Regulation 2004/2008 on the phasing out of MEHP as well as in Reg EC 1907/2006 on chemicals (REACH). In recent years even the use of first instar larvae of Chironomus riparius (Insecta, Diptera) has been proposed (OECD guideline n. 235, 2011) to be used to complement existing Test Guidelines for chromiordan chronic toxicity assays (OECD test guidelines 218, 219, 2004) (OECD Test Guideline n. 233, 2010). Chironomus riparius is generally used to test the acute toxicity of different daphnids, and this study showed the first day in the water column before becoming benthic for the other three larval stages. As a matter of fact, the Chironomus acute test can be a useful tool to control the conditions/sensitivity of the breeding organisms in the lab Therefore it can be of interest to understand its relevance when compared with the answers of other organisms, belonging to other taxa and with different life cycles. In order to compare the responses of Daphnia magna and Chironomus riparius when exposed to the same contaminant, we carried out different exposures using three different substances: two reference items (potassium chloride, and potassium dichromate, commonly used to test sensitivity of C. riparius and D. magna respectively) and an unknown toxicant (a fatty acid C14-C20). Preliminary results indicate possible differences in sensitivity to specific organisms; if confirmed by definitive tests, these observations may represent a warning when carrying out acute toxicity tests on water medium, confirming the importance to test different trophic levels and showing the need to further investigate the use of the acute test on Chironomus riparius according to OECD 235 to assess the acute toxicity on aquatic organisms.

TU139 Analysis of mixtures of bisphenol A and UV filters Octocrylene and OD-PABA on Chironomus riparius using a specific RT-PCR array
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Ana-Belén Muñoz-González, José-Luis Martinez-Guitarte, “Grupo de Biología y Toxicología Ambiental, Facultad de Ciencias, UNED. Madrid (Spain)Keywords: UV filters, BPA, RT-PCR array "The ultraviolet (UV) filters are main components of many personal care products (PCPs) that are extensively used. They are organic compounds defined as emergent contaminants, which are increasing their presence in the environment because their use in recreational and industrial activities. Described as endocrine disruptors in vertebrates, their effects on invertebrates have been poorly studied, especially in mixtures. On the other hand, Bisphenol A (BPA) is as plasticizer used in packaging and other industrial products with confirmed endocrine disruption activity. In this study we have used two common UV filters, octocrylene (OC) and 2-ethylhexyl 4-dimethylaminobenzoate (OD-PABA), and BPA to mimic the putative mixtures resulting from PCP and interactions with plastic of PCP containers. These mixtures may reach the biota of freshwater ecosystem so the main objective was studying of the effects that the mixtures can have on an invertebrate with a relevant role in the food chain of these ecosistems, Chironomus riparius. C. riparius is a dipteran with aquatic larvae frequently used in toxicity tests. Fourth instar larvae were exposed for 24 hours to single compounds and to binary and ternary mixtures. Effects on survival were measured by biotest. Here we report the results obtained by bioassay and Real-Time PCR using a specific array covering a variety of common biochemical pathways as well as some species improving also our knowledge about the mode of action of these compounds. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), CMT2015-64913-P/a/B.M.G is the receiver of a pre-doctoral contract from the National University of Distance Education (UNED).

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius
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Natural populations are constantly facing a large array of environmental stressors, from both natural and anthropogenic origin, which represent a strong selective force shaping the behaviour, physiology and morphology of organisms. Genetic diversity acts as a key component of evolutionary potential to adapt to changing environmental conditions. Ecological risk assessment needs to couple quantitative genetic analysis with ecotoxicological studies in order to understand the mechanisms underlying evolution of tolerance. Research on genetic variation regarding tolerance to contaminants has been mostly performed with clonal lineages. An alternative methodology has been applied for sexually reproducing organisms, evaluating the sensitivity to insecticides (genotypes) and estimating genetic variation in fitness traits. However, additional environmental stressors are not usually considered, limiting the predictive capabilities and determination of tolerance costs across different scenarios. The aim of this work was to assess genetic variation in tolerance in the aquatic insect Chironomus riparius exposed to microbial insecticides. A C. riparius population was established in the laboratory by crossbreeding five populations, in order to ensure sufficient levels of genetic diversity. By employing a full-familib split design, this study presents a quantitative genetic analysis among families of C. riparius across different environments (microbial insecticide exposure under two levels of salinity). Each egg mass was considered a single family (full-sib genotype). Within each family, larvae were randomly allocated to all treatments. Emergence rate, time to emergence and larval weight were used as response variables. Relationships between genetic variation, life-history traits and fitness costs in response to microbial insecticides, and the potential of a key aquatic insect species to evolve tolerance to these compounds will be discussed as well as an evolution of disease resistance on aquatic species. The study also highlights the suitability of C. riparius, a model organism in aquatic toxicology, for quantitative genetic analyses.

TU141 Effects of Amitraz on Chironomus riparius: life history and biochemical responses
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Amitraz is a very effective formamidinede insecticide used in agriculture to control froghoppers, mosquitoes, and cotton pests. One of the biggest concerns is the increase in rates, there is an elevated risk of contamination of adjacent aquatic ecosystems. However, the information of amitraz toxicity to aquatic non-target invertebrates is scarce. In this study, the toxicity of amitraz to the midge Chironomus riparius (Meigen) was assessed in terms of life history responses using standard ecotoxicological tests and biochemical endpoints using oxidative damage, antioxidant defenses, energy metabolism, and neuromuscular toxicity biomarkers. Chronic exposure to amitraz contaminated waters (28 days; 10, 20, 40, 80, and 160 μg L⁻¹) resulted in impairment of C. riparius emergence and developmental rates (reduced larval growth and delayed emergence), with male development time being
the most sensible endpoint (LOEC of 40 µg L⁻¹). Short-term exposures (48 h; 0, 10, 40, and 160 µg L⁻¹) to amitraz induced glutathione peroxidase activity and a decrease in catalase activity. Additionally, amitraz exposure caused a decrease in lactate dehydrogenase activity and a significant increase in electron transport system activity, both energy metabolism associated biomarkers. Regarding oxidative damage biomarkers, lipid peroxidation increased in C. riparius larvae exposed to Cu formulations, while there was a significant decrease in DNA damage levels at 10 and 40 µg L⁻¹ treatments. These results reveal possible biochemical targets of amitraz toxicity and suborganismal responses associated with amitraz exposure. The assessment of biochemical biomarkers may support the interpretation of toxic responses observed at organism level and therefore in the assessment of the ecological effects of environmental contamination. Moreover, it increases the information available on the outcomes of amitraz exposure in freshwater invertebrates, and underlines the importance of risk assessment studies of formamidine pesticides. Acknowledgements: This study had the support of the Fundação para a Ciência e a Tecnologia through project PROTEOME (PTDC/AAG-MAA/1302/2014), co-financed by COMPETE (POCI-01-0145-FEDER-016773).

TU142
Multigenerational exposure of Folsomia candida to copper agrochemicals: conventional and nano-pesticides
C. Malheiro, Department of Biology, University of Aveiro / Biology; A.R. Silva, University of Aveiro / Dept. of Biology & CESAM; D. Nunes Cardoso, CESAM, Unifever, University of Aveiro / department of Biology & CESAM; M. T. Trastman (U.S.), R. de Aveiro / department of Biology & CESAM; P. Silva, Universidade de Aveiro; J. Ulcer, University of Ljubljana / Department of Biology; F.J. Wrana, University of Calgary / Department of Biological Sciences; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology Agricultural practices include the use of agrochemicals for crop maintenance and increased productivity. Although soil contamination may result inorganics, agrochemicals, like copper pesticides, have been used in a range of agricultural applications, which may result in environmental problems. More recently, nanopesticides were introduced in the market with the intent to improve efficacy and decrease environmental negative effects. However, the chronic and acute ecotoxicological effects of nanopesticide exposure on soil biota are not well known since related environmental hazards are most often assessed using only the active ingredients. Moreover, the multigenerational effects of long-term, chronic exposure of soil organisms to agrochemical applications are unknown. The objective of this study was to evaluate the impact of long-term, multigenerational exposure of the soil collembola Folsomia candida to conventional and nanoparticle formulations of copper pesticides. Two formulations were assessed: Kocide® 3000 (nano form) and Champion® WP (conventional), as well as the pure active ingredient Cu(OH)₂ in spiked LUNA 2.2 soil. The effects of multigeneration exposure to the Cu pesticides were assessed using two soil treatments: 1) Cu spiking performed only at the beginning of the experiment and collembolan responses (survivorship, reproduction) measured for three generations (i.e., aging soil exposure); and, 2) Cu spiking performed at the start of each new cohort (fresh soil exposure). After three generations in both soil treatments, the surviving collembola were moved to uncontaminated soil for three generations to assess their recovery potential. Similar response patterns were observed in the two soil treatments for all three Cu formulations. Exposure to aging soils revealed an increasing tolerance across generations of F. candida. In contrast, in treatments with fresh soil, the collembolan populations showed ongoing sensitivity to Cu exposure. In both treatments, after being moved to clean soil, all treatment populations showed some recovery by displaying increased reproductive output. Copper forms presented difference between them in the long term exposure. This study, therefore, indicates pollution from different perspectives. However, there are still a few general studies on arthropods as indicators of environmental pollution. However, those that did worked on spiders, and underlines the importance of risk assessment studies of formamidine pesticides. Acknowledgements: This study had the support of the Fundação para a Ciência e a Tecnologia through project PROTEOME (PTDC/AAG-MAA/1302/2014), co-financed by COMPETE (POCI-01-0145-FEDER-016773).

TU143
Effects of multiple environmental stressors on Eisenia fetida coelomocytes: cell viability and different behaviour of amoebocytes and eleocytes
N. Silva-Vieira, University of the Basque Country / Zoology and Animal Cell Biology; Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU: E. Uriaranabarreneza, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology; M. Soto, University of the Basque Country / Zoology and Animal Cell Biology. Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU; E. Uriaranabarreneza, University of the Basque Country / Zoology and Animal Cell Biology, Research Centre for Experimental Marine Biology and Biotechnology PIEUVHEU. Earthworm immune cells (coelomocytes) have become a target system in ecotoxicology due to their sensitivity against a wide range of pollutants. Moreover, endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants at the endpoints measured in coelomocytes retrieved from exposed Eisenia fetida offer rapid and accurate information to predict impairments caused by pollutants. Therefore, the aim of the present work was to address the effects of different stressors (increase in temperature, low OM, model and emerging – nanoparticles- contaminants) on E. fetida coelomocytes by assessing mortality and changes in the relative proportion of subpopulations (amoebocytes, eleocytes). For that, earthworms were maintained under low OM content (6% vs. 10%), thermal stress (19ºC vs. 26ºC) and cadmium conditions (Cd: 5.25 mg/kg dw., Ag NPs: 0-100 mg/kg dw) in OECD soil during 3 days. After exposure of earthworms, coelomocytes were retrieved and viability was assessed in microplate through Calcein AM assay. In addition, flow cytometric analysis was used to determine mortality of coelomocytes and changes in the relative proportion amoebocytes/eleocytes. Coelomocytes extruded from earthworms maintained under low OM and high temperature showed a decrease in cell viability, but no changes were recorded in the relative proportion of amoebocytes and eleocytes. Exposure to Cd provoked higher mortality in eleocytes while Ag NPs caused more mortality in amoebocytes. Thus, we can conclude that the response of the different subpopulations was dependent on metal form and was enhanced by environmental factors (increased temperature and low OM). These results reinforce the potential use of E. fetida at cellular level for an accurate soil health assessment in a global warming scenario. Acknowledgements: Basque Gov (IT810-13), Univ. Basque Country / UFI 11/37 and MINECO (Nanosilveromics Prog).

TU144
Toxicity of abamectin and difenoxazolone, pure and formulated, to Folsomia candida
L.P. Figueiredo, University of São Paulo USP; G. Mainardi, Vrije Universiteit / Department of Ecological Science; C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science; D. Rodolfi, Vrije Universiteit / Department of Ecological Science. The progressive increase in the use of pesticides has been accompanied by effects at different levels of biological organization, implying losses of species and consequently of ecosystem services. Among the species utilized in terrestrial ecotoxicological tests, the springtail Folsomia candida (Collembola, Isotomidae) is one of the species suitable for assessing side-effects on terrestrial soil arthropods. In Brazil, the acaricide abamectine and the insecticide difenoxazolone are widely used in agriculture, but little data is available about their possible side effects on the soil community. The objective of this work therefore was to evaluate the effect of abamectine, pure and in the formulation Kraft®, and of difenoxazolone, pure and in the formulation Score®, on the reproduction of F. candida using a standard Lufa 2.2 soil. Juvenile F. candida, with age 10-12 d, were exposed following the standardized ISO and OECD test guidelines. The results were analyzed by analysis of variance (ANOVA) followed by Dunnett’s test at 5% significance level. Median lethal concentration (LC₅₀) was calculated using Trimmed Spearman Karber (TSK) and EC₅₀ and ECₑ₀ values for effects on reproduction were estimated using a logistic model. The results showed that both pesticides were more toxic in the formulation than when applied as pure active ingredient. For abamectin dosed as the formulation Kraft® EC₅₀ was 1.0 (0.17-1.8) mg/kg dry soil, while it was 6.3 (1.8-11) mg/kg dry soil for the pure active ingredient. For difenoxazolone applied as the formulation Score®, EC₅₀ was 53.5 (40.0-67.0) mg/kg dry soil while no effects on springtail reproduction were seen at concentrations of the pure active ingredient up to 333 mg/kg dry soil. The data indicate that it is essential to perform official formal repeat tests with pure active ingredients. It is currently unknown which component of the formulation causes the increased toxicity. Therefore, we are applying gene expression analyses to mechanistically understand increased toxicity levels caused by the tested formulations.

TU145
Terrestrial arthropods as indicators of environmental pollution
V. Lesch, North-West University; H. Bouwman, North-West University / Unit for Environmental Science and Management. In recent years, the use of and interest in terrestrial arthropods as indicators of environmental pollution has increased. Arthropods are diverse, with over 31,000 species described. Terrestrial arthropods are relatively easy to sample, and collection normally has less ethical restrictions than for higher animals. We interviewed the literature. We found relatively few general studies on arthropods as indicators of environmental pollution. However, those that did worked on spiders, bees, earthworms and ants. In addition, most studies favoured predatory species, since their high sensitivity gives insights into pollution in the area. In most studies, the sampling sites were close to old mines, or the studies were comparisons of arthropods from different locations. Published literature on terrestrial arthropods not only focuses on whole body utilization but also organ specific studies, as well as research on the use of arthropod products (such as honey and spider webs) as matrices for analyses. Most arthropods have a close association with soil, foliage, and air, representing pollution concentrations in the immediate environment. Each arthropod species occupy a unique niche and in doing so represent the concentration or degree of pollution in different ways. Each species, therefore, indicates pollution from different perspectives. However, there is still a
The impact of chlorpyrifos and its formulations on the acetylcholinesterase activity in non-target soil organisms

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Spray drift of pesticides has a negative impact on aquatic ecosystems and the environment, including damage to non-target organisms. Particularly, the drift of some insecticides can have detrimental effects on beneficial arthropods such as predatory mites. According to the recent EU Directive, the reduction of spray drift is required for a sustainable use of pesticides, yet without reduction of efficacy against pests. In this framework, eight field trials were conducted from 2012 to 2014 in two typical growing areas of Verona district (Northern Italy), four on apple orchards and four on vineyards. The aim of these trials was to evaluate, for two spray drift reduction techniques: 1) the spatial patterns of in-field droplets, 2) the efficacy against prey pests on apple (Cydia pomonella and Lobesia botrana respectively), 3) the side effects on predatory mite populations. Four insecticides, chlorpyrifos, chlorpyrifos-methyl, methoxyfenozide and spinetoram, were applied with three different spraying techniques: high-drift nozzles (Albuz, ATR 80), low-drift nozzles (Albuz, TV1 80015 green), and high-drift nozzles with an anti-drift adjuvant (rapeseed oil). Results showed that the two spray drift reduction techniques effectively increased droplets amounts next to sprayer, reducing potential drift on both apple orchards and vineyards and were generally as effective as standard nozzles without additional side effects on beneficial arthropods. Results suggest that the use of spray drift reduction techniques such as low-drift nozzles and anti-drift adjuvants can be effective in managing key pests and also in decreasing the environmental impact of using insecticides. Full article in: Crop Protection 98 (2017) 283-292; DOI:10.1016/j.cropro.2017.04.010.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (P)

TU149
Freshwater organism can recognize microplastics as microplastics
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The plastics are slowly weathered into nano- (< 100 nm) and micro- (< 5 mm) sized particles owing to physical, chemical, and biological processes in the environment. In the present study, we observed the behaviour of freshwater organisms and evaluated whether they recognize and respond to microplastics. Adult zebrafish was exposed to the different concentration of microplastic (MP, 250-300 μm) and food materials (F) (20 mg MP, MP20; 20 mg F, F20; 10 mg MP + 10 mg F, MP10F10). The behaviour patterns were recorded and quantified. Diving behavior of the adult zebrafish, which exposed under MP1F10 and F20 conditions, and the ingestion rate was quantified. The number of capturing patterns were counted as 21±4, 8±5, and 14±3 under F20, MP20, and MP10F10 conditions, meanwhile the spitting patterns were determined as 0.0±0.0, 2.8±1.3, and 0.2±0.4, respectively. Ingestion rate of diving behavior on control group was calculated as 0.63±0.10 zebrasfish wet/seg. The exposure group, which fed the MP10F10 exposed zebrafish, showed the significant decreasing (p < 0.05) of ingestion rate (0.55±0.08 zebrasfish wet/seg) during 591±85 seconds. On diving behavior, MP were only found at crop organ until 720 min after ingestion, and did not transfer to another organ. The digestive organs, especially crop, seemed to separate the microplastic as indigestible food. We concluded that the freshwater organisms recognize the microplastic, and exhibit the defence behaviour. This research was supported by B매는 Projects Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and future planning (2016R1A2B3010445).

Microplastic shedding from functional textiles
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Microplastic pollution of marine environment is an environmental issue which is intensely discussed on a global level. Synthetic based textiles contribute to microplastic pollution of the marine environment. Besides littering and the size-shape effects that microplastics have when being exposed to humans and animals they provide an additional vector for chemical pollutants, i.e. possibly providing a new entering mode into organisms of pollutants already existing in the sea. But fibers generated from consumer articles such as textile garments might carry chemical pollutants due to different chemical treatments. This study investigates effects (PA and polyester/cotton blended (PES/CO)) textiles that were functionalised with durable water repellent (DWR) treatment. The chemical treatment consists of polymers that are based on per- and polyfluoroalkyl substances (PFAS). Question 1: Do we have release of fluorinated fibers from functional textiles? Question 2: What is the amount of fluorinated fibers lost during the washing which can have an impact on the environment? The microscopic investigation identified fiber fragments, fiber fragments and the simulation of industrial washing (Gyro wash). Fiber fragments were identified with REM and the EDX analysis of showed fluoride (F) as part of the fiber surface.
composition. The results will be further verified using combustion ion chromatography (CIC) of shedded fibers with and without DWR treatment. These results will then be used to model a scenario simulating for instance Swedish consumption and use of DWR treated outdoor garments and the total exposure of fluorine contaminated fibers to the environment, from washing via waste water treatment to the recipient. This study proved that functional textiles can contribute to the release of microplastic pollution due to the formation of synthetic fiber fragments during washing. The presence of the fiber such composition confirmed that these fibers still contained traces of the functional DWR treatment. Released into the environment these fibers might be exposed to long term degradation processes which would finally cause the formation of persistent environmental pollutants. In addition the results of this study suggest that similar mechanism might be relevant for textile containing other functional coatings such as flame retardants, softeners or dyes as well.

TU151
Fate of 14C-labelled Calcium Poly(styrene sulphonate) (CaPSS) Microplastic in waste water treatment at environmentally relevant concentrations

Microplastic enters the wastewater e.g. as an ingredient of cosmetics or from specific pharmaceutical applications. Wastewater treatment plants (WWTPs) are generally considered to remove microplastic from the wastewater stream and to protect the receiving river. However, there is not much information to prove this assumption experimentally at environmentally relevant concentrations. This is due to the high sorption capacity of microplastics enabling them to become adsorbed onto other particles. Most WWTPs will therefore not be able to adsorb the microplastics into a complex sludge matrix at such low concentrations. In view of these limitations, the aim of this work was to determine the fate of a model polymer, crosslinked polystyrene sulfonate (PSS), in a simulated WWTP using radio labeled material. PSS is a polymer which is widely used as an ion exchange resin in various applications. The polymer is insoluble in water and is not degraded in the human body. Calcium loaded PSS (CaPSS) was synthesized in a procedure downscaled from an industrial method with 14C-radio labelled styrene monomer. This is a key step in the entire project as the radioactivity of the monomer interferes with the polymerization reaction. The resulting 14C-polymer was characterized by comparison with commercial non-labelled CaPSS to prove success. The 14C-radio labelled polymer was detected in sludge matrix as well as the effluent of the simulative wastewater treatment process. The potential water soluble degradation products and 14CO2 from mineralization. A mass balance was established to identify the most relevant processes for the fate of CaPSS in WWTPs. Due to the high sensitivity of 14C-detection, the test can be performed at realistic/environmentally relevant concentrations. As the detection limit of 14C-microplastics in environmental matrices is currently orders of magnitude lower than the potential water soluble degradation products and 14CO2 from mineralization. A mass balance was established to identify the most relevant processes for the fate of CaPSS in WWTPs. Due to the high sensitivity of 14C-detection, the test can be performed at realistic/environmentally relevant concentrations. As the detection limit of 14C-microplastics in environmental matrices is currently orders of magnitude lower than those orders of magnitude lower than those of CaPSS and not allowing data comparison between different studies (large-scale spatial and temporal comparisons). Hence, this work aims to assess the efficiency of different separation methods as an attempt to identify and establish the most cost-effective method. For that, artificial samples containing eleven plastics belonging to the most common types of polymers (e.g. low/high-density polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyethylene terephthalate) were prepared (secondary MPs) and subjected to different methods. These methods included density separation methods using sugar, olive oil and zinc chloride, as well as organic matter degradation methods using hydrogen peroxide (peroxo oxidation) and multienzymatic detergent (enzymatic digestion). The samples were then undergoing the detection, quantification and identification of polymers using a dissection microscope and Fourier transform infrared spectroscopy (FTIR). Several criteria were considered in order to achieve the aims of this work: efficiency of density separation and organic matter degradation, the total mass of recycled microplastics, the efficiency of each method, the simplicity and the quality of recovered polymers. Based on this multi-criteria approach, this study concludes that the wet peroxide oxidation with addition of zinc chloride was the most cost-effective method. This method should be used in future studies of monitoring of MPs in aquatic systems, notwithstanding the use of hydrogen peroxide must be cautious and only applied when necessary.

TU154
Applicability of remote sensing methods for indirect mapping of microplastic distribution within aquatic ecosystems
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Recently, there have been intensified research efforts to get reliable information about sources, sinks, and transportation pathways of microplastic in aquatic environments. Due to the high spatiotemporal variability of these systems, our knowledge of those aspects is still limited. Earth remote sensing is a key technology within the field of environmental monitoring, providing a unique tool for large area observations of water parameters such as suspended particulate matter, chlorophyll-a or colored dissolved organic matter. Since floating microplastic is probably influenced by the same transport mechanisms as non-motile plankton or floating debris and the hypothesis of a connection between microplastic and specific water parameters. In situ water parameters, microplastic (5mm – 250µm), and in situ derived spectral reflectance measurements (ASD FieldSpec) were taken during field campaigns at three different river mouths (Trape and Elbe in Germany, Po in Italy). Microplastics from surface waters were sampled with a manta trawl. Organic material was removed by enzymatic digestion and wet peroxide oxidation, and the remaining microplastics were analyzed down to plastic type with FT-IR as well as SWIR spectroscopy. Initial regression analysis results comparing microplastic with water parameters will be presented, and their suitability as indicators for microplastic abundance is discussed. Furthermore, simultaneously obtained remote sensing data for the river Elbe will be linked with in situ derived microplastic data and water parameters. If significant relationships between microplastic and water parameters exist, remote sensing of water parameters as an indicator for microplastic abundance would provide a cost-effective monitoring tool, able to cover much larger areas than feasible with ship-based point measurement.
Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ sample collections and ocean current modelling

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Plastic pollution in inland waters and the open ocean is a long recognized problem for marine wildlife, coral reefs, the fishing industry and shipping transport safety. Microplastics, defined as particles < 5 mm, form a considerable portion of this pollution and have recently received increasing public attention following recent discoveries that not only can these particles be ingested by planktonic animals, but also outnumber natural food items in some ocean areas. Ingested particles can induce negative survival effects as well as serve as introduction vectors for accumulated persistent organic pollutants (POPs) or carcinogenic plastic additives into the base of the food chain, potentially leading to many seafood products consumed by humans. Research has mainly concentrated on marine systems, and while a growing number of studies focus on freshwater lakes, river systems have to date received little attention. In particular, riverine plumes as an important influencing factor for the input and distribution of microplastics into coastal ocean areas remain largely unexplored. Here we present a study of the accumulation of microplastic particles emitted by the Po River along the Adriatic coastline in northern Italy. We posit that river-induced coastal microplastic accumulation can be predicted using a hydrodynamic model, supported by remote sensing data from LANDSAT and Sentinel-2A. Model accumulation maps were validated against in situ sampling at 9 beaches in the Po River mouth (particle size range: 1-5 mm). Hydrodynamic modelling suggests that the amount of discharged particles is only semi-coupled to beaching rates. Object tracking revealed that beaching of emitted particles was strongly mouth dependent and relatively low (less than 25% of all released particles from a given river mouth), primarily occurring within the first five days. The southernmost Po River mouth posed an exception, where more released particles (94%) were found to beach over an extended period of time and along a longer stretch of coastline. Comparison with remote sensing based accumulation maps and validation against in situ beach sampling are discussed. The presented methodology lays the groundwork for developing an operational monitoring system to assess microplastic pollution being emitted by a major river and its distribution along adjacent coastlines as well as into the open ocean.

Cause and effect of the plastic industry in South Africa as a developing country

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In 2017, the South African plastic industry has grown with 1.9%, compared with 2016 (Plastics SA). Although legislation is in place to promote recycling and sustainable use of natural resources, the recycling of plastic based materials is done predominantly by corporate initiative. Many South Africans believe that the country is lagging in terms of recycling. South Africa has however achieved a recycling rate of 41.8% in 2016, of which most is done post-consumer. Plastics SA has set an ideal of no plastics to landfills by 2030, and plans are being set in place to achieve this goal. Inadequate waste disposal infrastructure and protocols, especially in informal settlements causes large quantities of unrecycled plastic to end up in marine systems and subsequently in the marine environment. Beaches surrounding estuaries are heavily polluted with macroplastics which calls for greater prevention and clean-up efforts. Much effort is spent corporately to reduce South Africa’s ‘plastic footprint’, but efforts in terms of microplastics are trailing. We collected and filtered 46 fresh water samples from various localities in and around Gauteng, the most densely populated province in South Africa. High levels of plastic pollution were found in almost all samples. Up to 40 plastic particles (> 20 μm) per litre of surface water of the Vaal River, a major river in the country’s largest drainage basin flowing through industrialised areas. These levels are comparable to high levels of microplastic pollution found in European rivers. The growing plastics industry in South Africa requires excellence in clean-up and recycling to reduce the negative impacts on the environment and create a viable plastic sector.

Understanding the distribution and fate of microplastics in a tertiary sewage treatment plant in the UK

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Microplastics (MPs; < 0.5 mm) are classified as contaminants of emerging concern but currently are not regulated by water quality standards. Microplastics are highly diverse and their distribution in the environment is highly variable in space and time, making their quantification and risk assessment difficult. Further, their monitoring and regulation are hindered by limited empirical data, particularly of fresh- and wastewater systems as important pathways of land-based contaminants to oceans. Here, a study was conducted in a tertiary sewage treatment plant in the UK (Glasgow, Scotland) to assess the presence of MPs in the system and the effect of treatment stage in removing these contaminants before discharge into recipient freshwaters. The MPs were extracted from 5-litre samples, collected at a treatment stage, using H2O2 digestion and vacuum filtration through 1.2 μm GF filter. Characterisation and quantification of MPs was carried out by light microscopy followed by detailed chemical analysis of representative subsamples via SEM-EDS and FTIR-ATR. Microplastics were present in wastewater samples collected at all treatment stages, and abundances generally decreased from inflow to outflow. Further, high variability and peak abundances was evident across sampling dates. Chemical characterisation by SEM-EDS revealed that 94% of analysed pieces were C-based materials, but only 25% were confirmed plastics based on FTIR-ATR results. In conclusion, the tertiary treatment process evaluated here efficiently removes MPs entering the system but small quantities may still be discharged into the environment. Further, visual characterisation with light microscopy may result in overestimation of MPs due to misidentification of cellulose and other plastic microdebris as plastics. Therefore, analysis of chemical composition through a combination of detailed analytical techniques is crucial for improved accuracy of results. This study contributes to understanding what methods are needed to extract and identify MPs from environmental samples, and the spatio-temporal data generated provide understanding of what needs to be monitored and where controls should be implemented.

Weathering-induced changes in the effects of microplastic particles and their leachates

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Studies on the potential effects of microplastic (MP) particles in the aquatic environment are numerous. However, many laboratory studies apply spherical, pristine particles, which may be of limited relevance given UV light irradiation, mechanical stress, salinity, biofilm growth and other factors that can influence the weathering of the particles. It is therefore important to study the potential effects of microdebris as plastics. Therefore, analysis of chemical composition through a combination of detailed analytical techniques is crucial for improved accuracy of results. This study contributes to understanding what methods are needed to extract and identify MPs from environmental samples, and the spatio-temporal data generated provide understanding of what needs to be monitored and where controls should be implemented.

Impact of MP particles on organisms

We have exposed copepods, daphnia and algae to different fractions of virgin and weathered MP as well as particle-free leachates under controlled conditions. From the observation of apical endpoints in the acute toxicity assays, concentration-response relationships for the different fractions can be deduced. A critical evaluation of the suitability of the applied test protocols for the assessment of adverse effects of MP will be presented. (2) Influence of ageing plastic and leachates on biofilm structure and function: Biofilm formation on different types of aged and pristine polymeric substrates have been studied to observe the influence of weathering on the attachment and succession of biofilms. Sum parameters (biomass, pigment profiles, photosynthesis) and sequencing data were studied. (3) Mixture effects of leachates from the most common polymers: Cell-based bioassays have been applied to study mixture effects of additives and degradation products of the polymers liberated during weathering of plastic material in artificial seawater in agitated UV chambers. The chemicals in the seawater leachates were enriched by solid-phase extraction or chemicals were directly extracted from pristine particles by ultrasonic-assisted solvent extraction. The concentrated leachates and solvent extracts were then dosed into cell-based bioassays, covering i) cytotoxicity; ii) activation of metabolic pathways, e.g. via binding to the aryl hydrocarbon receptor; iii) specific, receptor-mediated effects such as estrogenicity; and iv) adaptative stress responses such as oxidative stress. The results may help to understand effects caused by additives and parent compounds opposed to the degradation products liberated from the UV-weathered plastic.

Occurrence and characteristics of fine microplastics in sewage water, domestic water, sewage treatment water and river water by coagulation and FT-IR microscopy method

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The occurrence of Microplastics (MPs) is of great concern in aquatic environment, especially ocean. Many current studies evaluate MPs ranged from 100 μm to 5 mm. However, MPs used in personal care products and other industrial processes are reported to be smaller according to previous reports. Because MPs are very
important substances to current economic activities, new materials for MPs will be needed such as cellulose. Though alternative of the materials is mainly conducted in personal care products, effect of the volunteer actions and various regulations on decrease of MPs in aquatic environments has not been evaluated. It is necessary to reveal their sources such as sewage water, sewage treatment water, wastes in agricultural environments and so on. This research shows occurrence and characteristics of MPs in sewage and freshwater systems, several treatment processes including microplastic in freshwater and by coagulation and FT-IR microscopy methods developed in our laboratory. MPs in the various contaminated water were collected by a plankton net whose mesh size is 10 µm. The collected particles were separated by a density separation method. After that, MPs in the collected particles were separated by coagulation process. Finally, the MPs were passed through a membrane and were identified by standard image processing software. Some MPs by FT-IR microscopy, MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectrumbased. This method is a source of MJPS in the terrestrial ecosystem and, through runoff, in surface waters. This research shows occurrence and characteristics of MPs in sewage and freshwater systems, several treatment processes including microplastics, while the estimated mass was 17.1 mg kg\(^{-1}\). The most abundant polymers/paints detected were polyester (30%), acrylic coating (32%), alkyd coating (10%) and polyethylene (7%). The particle size distribution showed the most abundant size ranges were between 20 - 40 µm and 80 - 150 µm. The high MP and MPP concentration measured in the sample highlights the harbor areas are potential hotspots for the accumulation and further spreading of MP and MPP in the terrestrial and aquatic environment. Microplastic and micro-particle paints were successfully extracted and detected in a recreational harbor area using the art analytical approach including multi-step sample preparation and FPA-µFTIR-Imaging analysis, the most suitable spectroscopic technique for an unbiased MP detection and quantification.

**TU160**

Detection of micro-paint particles and microplastic in harbour soil samples using FPA-µFTIR-Imaging-FTIR

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Microplastic (MP) pollution is nowadays recognized as a global concern affecting both marine, freshwater and also the terrestrial environment. Beside microplastic pollution, also micro-paint particles (MPP), originated by the degradation and abrasion of painted surfaces (buildings, ship-paint materials) have been reported in some recent studies. As many paints also contain organic compounds and heavy metals used as biocides aimed to inhibit the growth of biota on painted surfaces, these particles could be even more harmful to the environment and wildlife than microplastics. Here we present some results obtained from the analysis of soil samples collected in a recreational boat facility in the North of Denmark. A “Microplastic-based” approach has been used, extracting the particles from the soil matrix using air-assisted density separation followed by FPA-µFTIR-Imaging analysis. This approach allows to identify and quantify microplastics and micro-paint particles down to 10-20 µm in size. Surficial soil samples were collected along three transects located in different areas of the shipyard. The samples, previously sieved (500-500 µm and 500-10 µm) were submitted to flotation using ZnCl\(_2\) followed by sample cleanup using enzymes and H\(_2\)O\(_2\) oxidation to remove organic matter. The analysis was carried out using FPA-µFTIR-Imaging spectroscopy and the data were processed with a dedicated software (MPHunter) developed at Aalborg University. The first results highlighted a high micro-paint and microplastic particles contamination. The total MP and MPP concentration were 222,500 particles kg\(^{-1}\), while the estimated mass was 17.1 mg kg\(^{-1}\). The most abundant polymers/paints detected were polyester (30%), acrylic coating (32%), alkyd coating (10%) and polyethylene (7%). The particle size distribution showed the most abundant size ranges were between 20 - 40 µm and 80 - 150 µm. The high MP and MPP concentration measured in the sample highlights the harbor areas are potential hotspots for the accumulation and further spreading of MP and MPP in the terrestrial and aquatic environment. Microplastic and micro-particle paints were successfully extracted and detected in a recreational harbor area using the art analytical approach including multi-step sample preparation and FPA-µFTIR-Imaging analysis, the most suitable spectroscopic technique for an unbiased MP detection and quantification.

**TU161**

Runoff of microplastics from agricultural soil: a study in a semi-arid area

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Wastewater is considered to be one of the major sources of microplastics (MPs) entering surface waters. Although a high retention potential of wastewater treatment plants (WWTPs) for MPs in raw wastewater has been reported, the composition and transformation of MPs in treated wastewater is still not well understood. The aims of this study were (i) to evaluate the occurrence of MPs in surface waters, and (ii) to ascertain the MP contribution of WWTP effluents. The study was carried out in the Henares River watershed (Central Spain). Five WWTPs with differing dimensions (population equivalents between 10,000 and approx. 400,000), differing influent types (domestic, industrial, or both mixed), and differing treatment processes were selected. Wastewater inflow, outflow, and sludge (humid and dried) samples were collected during two different seasons (spring and autumn). In addition, river water and sediment samples were collected in three different seasons (spring, summer, and autumn) at three differently impacted sites: i) low human impact; ii) high agricultural impact; and iii) high mixed impact (urban, agricultural, industrial). MPs in river water and wastewater were divided into four fractions by filtering a suitable amount of water through plankton nets of different mesh sizes (from 300 to 200 nm). In order to assess the MP concentration and composition in the samples, solid substrates (sludge and river sediment) were subjected to an organic matter removal treatment, followed by density extraction. Subsequently, those samples, as well as the liquid samples (river and wastewater), were filtered onto filter papers to visually identify the MP content, and then chemically characterize their polymer type using FPA-µFTIR-Imaging microscopy. Finally, the more chlorinated characteristics of the watershed (total population, characteristics and location of WWTPs, agricultural land use patterns including sludge application, etc.) will be integrated into the study’s findings to deduce their importance for MP contamination. The preliminary results of the distribution and characterization of MP in different matrices are presented.

**TU163**

Microplastics occurrence and composition in drinking water from a Norwegian urban area

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Microplastics as a potential health and environmental problem has gained increasing attention recently. Microplastics is defined as plastic pieces smaller than 5 mm in diameter, and the sources of microplastics are many. State of the art literature reports that microplastics are ubiquitous worldwide. While several authors report frequently these particles in different parts of the environment, very little is known about occurrence of microplastics in the drinking water and their implications on human health. According to the WHO they should be consumed 3 L and women should consume 2.2 L of beverage per day. Most of these beverages consist of tap water, or drinks derived from tap water (such as coffee, tea, or reconstituted juice). The risk of plastic uptake from drinking water is currently unpredictable and furthermore, these plastic particles are in addition to plastics potentially consumed in other sources, such as sea salt, beer, and food and seafood. The research tasks of the present work were: Map published and available literature, develop and optimize a standardized fast, sensitive protocol for sampling and quantification of nano/microplastics particles in drinking water and finally. Analyze and possibly
detect microplastic particles in drinking water supply systems with special focus on different polymeric composition and size fractions. Study area was the Rogaland area (Norway) populated by approx 110,000 inhabitants. Samples of drinking water were collected every two week for ten months contemporary from the supply water and system collection point as well as in different sites of the urban area. A fast and sensitive method based on a GC-MS/pyrolysis was developed. Polyethylene, Polypropylene and Polyvinyl chloride were the most recurrent polymers. Levels ranged from 0,02 to 16 ng/L. Time and space related trend are presented.

TU164 Macro and Micro(plastics) in the Environment of Some French rivers

This work represents one of the first studies on the occurrence of microplastics in river flows through the city centre of Edmonton, Alberta, the fifth largest city in Canada. The study included the French river Allier, which flows through the city, including sites both upstream and downstream of the city and potential point sources (i.e., a wastewater treatment plant, WWTP). Microplastics were found in all samples, and at some sites concentrations exceeded those reported in other urbanized rivers. Various colour fragments, films, beads, and fibers were identified, with the majority of microplastic composition being in the form of fragments. Both the total concentrations and the proportion of each type of plastic varied with distance downstream and size class, suggesting changing inputs as the river flows through the city. No differences in either concentration or composition were found between sites upstream and downstream of the WWTP, suggesting a lack of significant input to the river. Moving forward, the chemical composition of suspected microplastics will be investigated using Raman microspectrophotometry. This work represents one of the first studies on the occurrence of microplastics in the freshwater environment in Western Canada and will provide a baseline for future monitoring studies.

TU166 A Historical Sediment Record of Microplastics in an Urban Lake, London, UK

A historical record of microplastics extracted from a radionuclide (147Pb and 13Cs) dated sediment core from a London lake provides novel data on the long-term deposition of microplastic waste in freshwater systems. Microplastic particulate abundance and calculated accumulation rates are indicative of plastic usage in the 20th century. Concentrations of microplastics extracted from the sediment, by sieving and floatation using dense liquid separation range from 30 to 880 particles per kg of dried sediment. Fibres dominate the assemblage of microplastic particles identified in the time-resolved sediment samples. Polyurethane microplastic particles were identified and are found in post-1950s sediment and up to the present day. An increase in microplastic concentration is evident in recent sediments (post 2000) but a peak in concentration is also observed in late 1960s-1970s age sediment. Raman spectroscopy of selected particles and fibres provides compositional data on the fibres and particles found in the sediment. The size and nature of microplastic particles found in the sediment, as well as their changes over the past century, suggest that atmospheric deposition has been an important vector of plastic transport to the lake. Microplastic analysis of temporally well-resolved lake sediment sequences will greatly assist in quantifying the historical influx of microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.
campaigns and for communicating risks associated with microplastics in terrestrial and freshwater environments. We illustrate these concepts using data from Swedish and Canadian catchments. Our results show the importance of autumn storms and spring snowmelt for microplastic mobilisation to surface waters and highlight the potential knowledge gains associated with targeted sampling of riverine sediments, constructed wetlands and waste treatment facilities.

TU169 Occurrence and concentration of microplastics in an urban river C. Campañale, C. Massarelli, G. Bagnuolo, Italian National Research Council; V. Urcichio, Italian National Research Council / Water Research Institute

The term ‘microplastics’ was first used in 2004 to describe very small fragments of plastic (< 50 μm) in the water column and in sediments. In 2009, K. I. van der Zwaan, J. Lamprecht, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience; C. Zarfl, University of Tuebingen / Center for Environmental Science and Analytical Chemistry (ACES)

Microplastics (MP) have been identified as a potential environmental hazard, which has motivated a wide range of effect studies, testing different combinations of polymer types and shapes. However, risk assessment of MP exposure, in the lower size range (< 100μm), is today hampered by both the lack of data regarding their presence in the environment and the inadequate experimental design of many effect-studies. A crucial issue in designing such studies is to include control particles that are ubiquitously present in the environment and represent a background variability with regard to suspended solids. Such controls, allow effects ranking of particles in the respective separation from the matrix.

This separation is crucial for testing MP-specific effects, as many test organisms are suspension-feeders that have evolved in turbid aquatic environments. To highlight and provide examples of the importance of particle controls in MP-effect studies we will present: I) results of a review on effects of particle suspensions (MP, or natural nutritionally inert particles), and II) case studies employing control particles. The data strongly suggest that particle controls are essential for identification of MP-specific effects, so that MP impacts can be assessed based on ecological soundness.

TU170 Influence of environmental conditions on the sorption of organic pollutants to microplastics in aquatic environments S. Seidensticker, J. Lamprecht, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience; C. Zarfl, University of Tuebingen / Center for Applied Geoscience

The ubiquitous contamination of all environmental compartments with microplastic particles is extensively discussed in both science and public. Large numbers of microplastics have been measured in effluents of wastewater treatment plants. These particles might act as sorbent and transporter for frequently occurring micropollutants like pharmaceuticals, can be charged under certain pH conditions. While it is known for a wide variety of natural particles that charged compounds sorb only little or not at all, sorption interactions between microplastics and charged compounds have not been analysed so far. This is mainly because of the difficulty of analytical methods available to quantify such interactions. Here, we present novel experimental approaches to study the sorption of charged compounds to microplastics and discuss first results.

Results show a wide variety in their physico-chemical properties, e.g. a log \( K_f \) range between 0.1 and 3.8 and \( K_w \) values from 1.6 to 13.9. We performed batch experiments with fourteen ionizable and five non-ionizable substances. In all experiments equilibrium was reached after two days. Measured log \( K_f \) for the neutral species ranged from 0.75 to 4.00. The uptake of contaminants varied according to their hydrophobicity. Sorption of ionizable substances is strongly influenced by the pH while non-ionizable substances showed a partitioning independent of pH. For sorption into polyethylene, the amount of accumulated pollutants is principally dominated by the neutral fraction, while the charged
species did not contribute. Thus, with increasing pH sorption of acids decreased while the sorption of bases increased. Whereas electrostatic interactions between charged species and polyethylene could not be detected, this might be different for other polymers, such as polystyrene and polyamide.

TU174 Influence of microplastics on transport of organic contaminants in soil T. Huffer, S. Slaweck, T. Hofmann, University of Vienna / Department of Environmental Geosciences
The worldwide production and usage of mainly disposable plastic has increased from 1.7 million tons in 1950 to 299 million tons in 2013 [1]. Consequently, plastic wastes are deposited in the environment and persist due to long durability and limited recovery [2]. Polyethylene is one of the mass-manufactured polymers that is found in the terrestrial environment, used in many different sectors, including agricultural mulches, composite and package material [3]. To date, microplastics have been mainly studied in marine and freshwater systems, whereas there is hardly any data on microplastic occurrence, fate, and effect in terrestrial environments [2]. Low-density polyethylene (LDPE) foils, that may become brittle due to isolation, are used in large amounts on agricultural areas to protect crops, suppress weeds, regulate the temperature and retain irrigation water in the soils [1]. In soil microplastics may affect the transport of hydrophobic organic pollutants and pesticides, as they can be preferentially sorbed by polymer particles with large surface to volume ratio compared to sorption by natural sorbents [1, 4]. The strength of sorption as well as the relevant molecular interactions depend on the prototoxicity, because they can increase [5]. The objective of this study is to investigate the influence of microplastics on the transport of organic contaminants in a soil under varying aqueous conditions. [1] K. Dui, A. Coors, Environ. Sci. Eur. 2016, 28, 2. [2] M. Rillig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornin, M. Bijarimi, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rowland, R. Thompson. Mar. Pollut. Bull. 2012, 64, 7828. [5] T. Huffer, T. Hofmann, Environ. Pollut. 2016, 214, 194.

TU175 Influence of polystyrene microplastics in combination with organic pesticides on the giant rams-horn snail Marisa cornuarietis: behavioral and biochemical responses S. Krais, University of Tübingen / Animal Physiological Ecology; H. Schmiegel, Tübingen University / Animal Physiological Ecology; E.E. May, University of Tübingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tübingen / Animal Physiological Ecology; R. Triebkorn, University of Tübingen / Animal Physiological Ecology. In the last two decades, the quantity of globally produced synthetic polymers rises continuously in high amounts of plastic debris of all sizes in the environment. Very small-sized particles and fibers (< 5 mm) which are defined as microplastics result either from degradation of macroplastics or are produced as primary microplastics which are contained e.g. in cosmetics. Microplastics are of particular interest in ecotoxicology, because they can be end-up in tissues like pesticides or pharmaceuticals, transport them into food chains and modulate their toxicities. In addition, they can mechanically affect exposed organisms. Whereas in the past, most of the studies on microplastics have focused on the marine environment, there is still little knowledge about the occurrence and impacts of microplastics in freshwater ecosystems. The aim of this study is to examine possible influences of polystyrene particles in combination with different organic pesticides on the behavior and biochemical responses of the giant rams-horn snail (Marisa cornuarietis). Snails were exposed to 10 000 polystyrene particles per liter (crogenucgenically milled, < 100 μm) in combination with different concentrations of the pesticides cypermethrin, methiocarb and thiacloprid. In order to quantify the observed behavioral responses, five categories of behavior were defined, which are “crawling”, “attached to the wall”, “attached above the water surface”, “inactive on the ground” and “retracted with closed operculum”. All snails were individually categorized twice a day for nine days. The results make evident that snails exposed to cypermethrin significantly changed their behavior between the first (day 1-4) and second (day 5-9) observation period, independent of the test concentration. In the first period, they were often categorized as “attached to the wall” or “attached above the water surface”, whereas in the second observation period, these snails were mainly classified as “inactive” or “retracted”. As biochemical endpoints we study oxidative stress (lipid hydroperoxides, superoxide dismutase), proteotoxicity (Hsp70 level) and neurotoxicity (inhibition of acetylcholinesterase). The analyses, however, are still in progress. The study is part of the joint research project MiWa (“microplastics in the water cycle”) funded by the German Federal Ministry of Education and Research (support code: 02WRS1378).

TU176 Effects of artificial weathering on polypropylene microplastics V. Fernández-Gonzalez, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); G. Gueiro-Noche, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); J.M. Andrade-Garda, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); P. López-Mahía, Universidad de Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Muniategui, Universidade da Coruña / Analytical Chemistry
Microplastics are defined as plastic materials or fragments with diameter below 5 mm. These microplastics occur due to the release of manufactured (primary) microplastics in various products and the breakdown of larger plastic litter (secondary microplastics). The time required for plastic to degrade under natural conditions is estimated to be on the order of thousands of years by photo-oxidation by UV light its primary degradation pathway. The small fragments of microplastic created by weathering are detrimental to ocean ecosystems for multiple reasons. In the frame of the BASEMAM project (JPI Oceans) 9 natural microplastics of different polymers materials, in two size presentations (100-500 μm and pellets ≤ 1 mm) were artificially weathered. A pilot-scale simulated weathering system (dry conditions and simulated marine conditions), using UV/Vis metal halide lamps, was deployed. This study focuses on the characterization of the changes that an accelerated artificial weathering process produces in polypropylene microplastics using ATR-FTIR. This could be useful to identify real plastics and microplastics found in marine environment, and understand how aging affects the surface and chemical structure of this material. New absorption peaks can be seen, that reveal changes in the main structure of the microplastics. Some indexes were calculated as the ratio of these IR bands to a reference peak that indicate oxidized carbon in the plastic hydrocarbon chain. It is worth to note that the direct identification of the type of polymer is usually not possible. Weathering-related changes in the IR spectra differ the correct identification of the polymer when are compared with the IR polymer library. Moreover SEM microscopy was also done laboratory studies. Effects are typically dose-dependent. SEM images revealed that the microplastics experienced mechanical erosion and weathering. These results reveal that an adequate pretreatment of the sample along with an adequate customized polymer library that contains real/weathered polymers spectra are highly recommended for the adequate monitoring of microplastics in the environment. Acknowledgements: Program of Consolidation and Structuring of Units of Competitiveness: PCIN-CTM2016-00165; Ministry of Economy and Competitiveness: PCIN-2015-170-C02-01 BASEMAM-JPI Oceans and, project CTM2016-77945-C3-3-R (ARPA-ACUA).

TU177 Freshwater microplastics and effect of conditioning on pollutant and chemical transfer potential K. Reilly, The University of Birmingham; J. Sadler, The University of Birmingham / Department of Geography and Environmental Science; I. Lynch, University of Birmingham / Geography Earth Environmental Science
The presence of microplastics in the environment has received increasing scientific and societal interest over recent years. Following this, there has been a range of scientific studies and discussions on impacts that microplastics are having in the environment and how we can mitigate this, leading to changes in legislation, although more is needed. Micro, and recently nano, plastics have been shown to have a range of detrimental effects on various organisms in both field and laboratory studies. Effects are typically dose-dependent. SEM images revealed that plastic conditioned under different scenarios can have on the interaction with Daphnia magna (a keystone species). We assessed this using several parameters including: (1) quantifying the proteins and polysaccharides secreted by the organism’s before and after exposure, (2) quantifying uptake of plastic in the individual organisms, and (3) observing changes in behaviour (reproduction and movement). We explored these effects for pristine plastics and plastics combined with chemicals commonly found in the environment, including 17α ethynylerestradiol and detergents. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on both adsorption and desorption of the target chemicals on the plastic’s surface was a key element of this study, to assess how microplastics interact with chemicals in more complex pollution issue in the environment. This study could help to explore the issue of combined stressors using parameters that can be controlled in the laboratory. Through this, we can assess the impact of assumptions about test conditions, and the impact of over-simplification of standardised test media, on the resulting data regarding the Trojan-horse potential of micro and nano plastics. Building on this data we will create recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.

TU178 Exposure to conventional but not biodegradable microplastics impacts fitness in Daphnia magna Z. Gerdes, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); M. Puranen, Stockholm University; M. Ogonowski, E. Gorokhova, Stockholm University / Department of Environmental Science and
Analytical Chemistry (ACES)

Conventional, oil-based polymers are considered as the major source of microplastic pollution, whereas biodegradable polymers (bioplastics) have not attracted much attention as sources of microplastics. However, given that the production of bioplastics is increasing and that biodegradation is slow under ambient conditions, it is likely that they enter the aquatic environment in the same way as other types of plastic. Therefore, it is important to understand potential environmental impacts of both polymer types. We compared effects of exposure to polylactic acid (PLA; bioplastic) and polystyrene (PS; oil-based polymer) on primary life history traits in the crustacean Daphnia magna, a standard species in ecotoxicology. To exclude particle effects caused by food dilution and thus identify microplastic-specific effects, kaolin clay was used as a reference treatment. In total, four treatments were included: PLA, PS, clay (reference), and control (food only). The exposure was conducted over 21 d using a plankton wheel to keep test particles and algae in suspension for comparable exposure concentrations. In the PS treatment, we observed high mortality, decreased feeding rate and reproductive output compared to all other treatments. These effects were not caused by toxic monomers of styrene or additives leaching out of the polymer, which was demonstrated in a follow-up test with the PS leachates. By contrast, no significant effects were found in the daphnids exposed to PLA compared to the reference treatment. Thus, a significantly higher toxicity of the conventional polymer was observed, whereas effects of the biodegradable microplastics were similar to those caused by the ubiquitously occurring clay particles. More studies are needed to identify the mechanisms of PS toxicity and to confirm the observed ecological fractionation of > 28 µm, up to 100,000 particles/L, to the polymer type using different materials. To evaluate toxicity of these materials, it is essential to include a reference treatment as a benchmark.

TU181 Evaluation of chronic toxicity of polystyrene microplastics on freshwater mussels

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The annual global plastic production follows a positive trend and plastic pollution represents an emerging worldwide issue. In particular, microplastics (MPs), plastic fragment smaller than 5 mm, are potentially dangerous for aquatic communities because their ability to be accumulating in the tissues of biota. MPs can reach the aquatic environment through the Wastewater Treatment Plants (WWTPs) or affecting the degradation of microplastics. Considering that few studies, especially in freshwater environment, have been conducted about the adverse effects of MPs, the aim of our study is the evaluation of chronic toxicity of these contaminants on the freshwater mussel Dreissena polymorpha using a multi-biomarker approach. As MP standards we choose two different beads of polystyrene, one of the most common MP classes detected in the environment, with a size of 1 and 10 µm. On the basis of the daily great release of MPs from WWTPs, we tested the following mixtures (MIXs) of polystyrene MPs: MIX1, which contained 2 million/L of 10 µm MPs and 2 million/L of 1 µm MPs, and MIX2, which contained 500,000/L of 10 µm MPs and 500,000/L of 1 µm MPs. Therefore, mussels were exposed for 7 days in static conditions to the MIXs and to related control, every 3 days we collected from each tank the mussels to assess both chronic toxicity and uptake of polystyrene MPs. We evaluated the adverse effects by monitoring end-points of cellular stress, as the activity of antioxidant and detoxifying enzymes, oxidative damage, cyto-genotoxicity and neurotoxicity (analyses in progress). To evaluate the uptake of polystyrene MPs in the exposed mussels, exploiting the reflection of MPs, we collected hemolymph and then fixed them on a soft tissue for cryostat sectioning. We then observed the samples using the confocal microscopy. Despite we found both sizes of polystyrene MPs in the hemolymph and soft tissues of mussels, we did not obtain significant increase of tested biomarkers compared to control, excepted for a significant increase of CAT activity at the end of exposure for mussels exposed to MIX 2. The lack of adverse effects induced by tested MPs could suggest that the toxicity of MPs could be related to their size, to MP sorption toward chemicals, or involved in metabolic pathways not detectable by our biomarkers. In addition, prolonging the exposure time the MP toxicity could be increased.

TU182 Polystyrene microplastic effects on the lipid peroxidation and antioxidant capacity in non- and temperature-stressed individuals of Dreissena polymorpha

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Microplastic (MP) toxicity has been considered in numerous taxa including bivalves, which are of special interest due to their high filtration activity and therefore MP particle uptake. Previous studies in marine bivalves reported stress and inflammation processes in response to high levels of MP exposure, while data on freshwater species are missing. Therefore, we analyzed the effects of irregular polystyrene MP (< 63 µm) on the lipid peroxidation and antioxidant capacity in the freshwater bivalve Dreissena polymorpha both in a single and multiple stressor exposure regime. We exposed D. polymorpha to polystyrene MP at concentrations between 6.4 and 100,000 µm L−1 over 6 weeks at 16 °C. After the exposure, the mussels were incubated with a medium containing 100 µM hydrocarbon per day for 48 h. At the end of the exposure, we analyzed the effects of MP exposure on the antioxidant capacity (ORAC assay, oxygen radical absorbance capacity) – an estimate of the remaining antioxidant capacity. The analysis of lipid peroxidation...
and antioxidant capacity did not indicate any increased stress levels in response to chronic MP exposure in D. polymorpha. In addition, the same experiment performed in a sub-chronic exposure (1, 3 and 7 d) did not reveal stress-induced effects either. Therefore, this study indicates that polystyrene MP does not induce a stress response in D. polymorpha in the current exposure scenario. In a more environmentally realistic scenario, bivalves will experience other stressors (e.g. increased water temperature) besides particulate matter. Thus, we hypothesize that a stress response can be moderated by MP exposure. To explore such a scenario further, we will present results from ongoing multiple-stressor experiments in which we expose D. polymorpha to MP at 16, 24 and 28 °C.

TU185
Tissue Translocation of Polystyrene Micro- and Nanoparticles in Daphnia magna?
C. Schleg, Goethe University Frankfurt / Dpt. Aquatic Ecotoxicology; S. Rist, DTU (Technical University of Denmark) / Department of Environmental Engineering; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; M. Wagenius, Norwegian University of Science and Technology / Department of Biology

The last decade has seen a surge in research investigating various aspects of micro- and nanoplastics originating from plastic pollution in aquatic ecosystems. Aspects include occurrence, uptake, and potential effects in biota. Working with particles in a laboratory setting bears its own kind of challenges, some of which had already been faced by researchers in the realm of nanotoxicology. Our goal was to elucidate biota-particle-interactions is still limited and often based on early studies that – due to the infancy of the field – may have deficiencies in the experimental design and quality controls. One such example relates to the potential of plastic particles to cross the gut epithelium and translocate to other tissues. This phenomenon has been reported in the literature for the freshwater cladoceran Daphnia magna and – if true – may result in the formation of lymphoid organs. To substantiate the limited available data, the aim of our study was to replicate these findings. We exposed neonate daphnids in a number of scenarios regarding particle concentration and exposure duration at two independent geographical locations using animals from two separate cultures. We expanded on the previous experiment by improving imaging through the addition of a confocal-based clearing followed by investigation through confocal laser scanning microscopy. We additionally applied the lipophilic dye nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoparticles. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microparticles under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body and affect regulatory measures in the environment. We conclude that further research on biota-particle interactions is required in order to fill the gaps in knowledge about how micro- and nanoplastics enter the food web and affect the organisms that consume particles.

TU186
Analysis of the Trojan horse effect of a mixture of microplastics and chloryrlfop in an aquatic microcosm study
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Microplastic particles (MP) are of concern in the aquatic environment because of their increasing amounts in production and release into the environment. Beside their physical adverse effects, MP can sorb hydrophobic chemicals, which can then be transported together into biota by the so-called ‘Trojan horse’ effect. In this study, a higher CPF could with a complex ecosystem was performed with the aim to discover the Trojan horse effect by means of a laboratory aquatic microcosm study. The insecticide chlorpyrifos (CPF) was used sorbed to 5 μm polyethylene microbeads. Beside the control microcosms (C), an MP-control (MPC) group was treated with 4 mg MP/L. For two other treatment groups, the same concentration of MP was coated with nominal CPF concentrations of 0.5 μg/L (L) and 0.5 μg/L (H) in the water phase. In order to measure CPF exposure, the experiment run for 14 days was performed. Since CPF could not be detected in neither of them, a strong sorption of CPF to MP is indicated. Abundances of Daphnia pulex revealed higher population increments in MPC than in C, L and H, indicating higher reproduction rates in the first two weeks after application. Furthermore, body lengths of juvenile D. pulex remained nearly constant during the test period in all MP treatments (MPC, L, H) while they increased in the control group (C). Interpreting these results, MP might have led to higher reproduction rates as a stress response which were lowered when CPF was present. In this case, CPF must have become bioavailable to D. pulex after ingestion of MP. For C. pseudogracilis, total abundances increased the most in MPC, whereas L and H developed similar as C. As for the cladoceran, MP might have led to higher reproduction rates that were lowered by CPF. The Trojan horse effect has probably not been caused by CPF because the control group (C) increased in abundance faster than the other treatment groups L and H (day 14) was performed. Though, the reason why the presence of MP (without CPF) might have led to enhanced abundance levels still needs to be clarified.
feeding with microparticles contaminated food has consequences on juvenile fish growth. Taken together, our study demonstrates the power and limits of flow cytometry/viSNE for microplastics quantification in a complex biological matrix like fish. The setup could be extended to other types and forms of microplastics in different environmental matrices. Moreover, our study sheds light on ecological consequences that microplastics exposure might have on fish.

TU187
Microplastic ingestion by fish: a comparison of Thames Estuary and Firth of Clyde populations
A.R. McGoran, Royal Holloway; P.R. Cowie, Field Studies Council Scotland; P.F. Clark, The Natural History Museum; J.P. McEvoy, D. Morriss, Royal Holloway
This study compares the ingestion of microplastic by pelagic and benthic fish populations from two major UK watersheds: the Thames Estuary and the Firth of Clyde. A total of 760 fish from 20 species and 116 brown shrimp, Crangon crangon, were sampled. Individuals were examined under a dissection microscope and potential plastics were removed to be later identified by FTIR analysis. Out of 21 species, including both fish and shrimp, sixteen species from different trophic levels ingested plastics. Overall, between 1.3 and 47% of fish ingested plastic fibres (85% of potential plastics; before FTIR analysis). In addition, microplastics were also found in the stomach of a common prey species, C. crangon, but had ingested far less plastic than predatory fish species, such as the European flounder, Platichthys flesus. In the Firth of Clyde, benthic, flatfish ingested significantly more plastic than pelagic fish and other benthic fish. This may indicate that, in estuarine systems, plastics accumulate in the sediment.

TU188
Polystyrene microplastic uptake and effects on feeding behaviour and reproduction in the cladoceran Daphnia magna
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Plastic contamination is a well-known environmental problem as demonstrated by the huge presence of plastic debris ranging different sizes in diverse aquatic ecosystems worldwide. In recent years, the attention has been attracted by microplastics (MPs), small plastic particles (dimensional range Daphnia magna affecting food intake, growth and reproduction. First, we performed a 24 hours uptake and 48 hours release test to assess the ingestion and elimination rate of MPs in daphnids. Already after 1 hour of exposure we found that MPs fill up the digestive tract of daphnids at all the tested concentrations. On the other hand, results after 24 and 48 hours after exposure of MPs were still found massively in the digestive tract of treated individuals. The lack of a complete release of MPs can cause the blockage of the digestive tract and starvation, leading the crustacean to the death. Moreover, these effects can negatively affect body growth, swimming activity and, consequently, have strong consequences on reproduction, as suggest by a standard 21-day reproduction test.

TU189
Uptake of differently sized microplastics in gut passage by different species of Daphnia
S. SUELAN, University of Birmingham; I. Lynch, University of Birmingham / Geography Earth Environmental Science; J. Sadler, The University of Birmingham / Geography Earth Environmental Science
Plastic-debris, for example from textile weathering and washing, are increasingly accumulating in aquatic environments, and while they are now recognized as environmental pollutants, their impact on aquatic ecosystems is not yet fully understood (Jemec, 2016). Microplastics, which are synthetic polymers with a diameter smaller than 5 mm and extending down to the nanoscale, have a widespread occurrence and negative effects on different trophic levels have been described (Hollman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filterators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2.0-3.5 mm) to D. pulex (1.3-2.0 mm) which spans a similar range of sizes as micro and nanoplastics, thus suggesting that different members of this family may be differentially sensitive to or affected by different sizes of micro or nano plastics. This work presents a first analysis of the effect of Daphnia body and gut size on uptake of microplastics of different sizes. We investigated the ingestion and effects of polyeal bead carboxylate microspheres (0.1, 1.0 and 10 μm) on freshwater cladocera of different body sizes (D. magna, D. pulex and D. galeata) after 24, 48, and 72 hours exposure to a range of mass concentrations (also compared on the basis of particle number) (Nasser, 2016). The hypothesis tested was that the size of microplastic particles preferentially taken up by the organisms will scale with organism size, due to differences in their gut sizes and filter feeding capabilities. We assessed the uptake, accumulation, and depuration of the microplastics in Daphnia species using stereomicroscope (Nikon SMZ2000) measurements. Image analysis approaches (ImageJ and Matlab) were utilised to calculate gut area, and pixel density within the gut, in an effort to quantify particle uptake. This was correlated with fluorescence measurements using fluorescence-labelled microplastics, corrected for the average fluorescence per particle. Rapid accumulation in the gastrointestinal tract was observed after exposure to all particle sizes in D. magna, with the smaller particle sizes being detectable in the guts of neonates of all three species. The comparative uptake and effects of polyethylene microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU190
Determination of microplastics in mackerel stools by enzymatic digestion and µFTIR
G. Grueiro-Noche, Universidade da Coru ña / Grupo Química Analítica Aplicada (QANAP); V. Fernández-González, J.M. Andrade-Garduño, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); P. Lópezej-Mahía, Universidade da Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Munatgeu, Universidade da Coruña / Analytical Chemistry
Plastic is one of the most used materials in the world and is one of the most common and persistent pollutants in the oceans. In fact, plastics constitute 60-80% of marine litter. A particular fraction of plastic debris are the microplastics (5-1000 μm; e.g. Fundan BASEMAN (JPI Oceans) and, project CTM2016-77945-C3-3-R (ARPA-AUCU).


TU191
Microplastic contamination of the model system Weser-National Park Wadden Sea: an across-ecosystem approach
S. Moses, University of Bayreuth / Animal Ecology I; M. Loeder, I. Schrank, C. Lafortez, University of Bayreuth / Animal Ecology I
For the first time worldwide, in the joint project PLAWES the pollution with microplastics of a large European river basin will be investigated on the example of the model system Weser-National Park Wadden Sea. PLAWES, as a pioneer study, is going to conduct an interdisciplinary and ecosystem overarching analysis concerning the contamination with microplastics from the headstreams to the North Sea, thereby considering exemplarily major point (e.g. wastewater treatment plants, combined sewer systems) and diffuse (drainage, atmosphere) sources and entry routes. The new insights are going to be included in a new modeling concept for the identification of primary transport mechanisms and accumulation zones of microplastics. Effects of microplastics on ecosystems of the Weser-Wadden Sea system will be investigated on both, aquatic invertebrates and the interaction of pathogens with microplastics in biofilms. The insights on ecologically relevant aspects are going to be used to assess the environmental effects of microplastics on the model system Weser-National Park Wadden Sea and to transfer these to other systems. Furthermore, the results will be used to develop novel teaching materials to provide an education platform for teachers, pupils and parents across Europe. Hence, PLAWES will generate unique data on the impacts of microplastics on a large European river basin and on environmental health. This will not only be instrumental for decision makers and stakeholders but also serve as focal point to develop science-based solutions.

TU192
Phochochemical fragmentation of freshwater (microplastics under UV irradiations
V_Verney, CNRS - ICCF / Photochimic-CVP; G. BISSAGOU KOUMBA, UCA-ICCF; F. Delor Jestin, Sigma-ICCF
We begin to understand and describe more and more the fate of a plastic waste arriving (and remaining) in the aquatic environment. Nevertheless, we still do not know many things, for example, the time scaling of the process from the abandonment of a waste, its arrival, and its persistence in the aquatic environment. During this period, the material will be exposed to various environmental aggressions that will initiate and spread the photoaging of the material. This scenario is accompanied by a physical fragmentation into smaller sizes, and the chemical functionalization due to the photo-oxidation of the macromolecular chains. Finally, the increase in both the specific surface area and the chemical functionality may influence strongly the interaction parameters with persistent organic pollutants. We have studied, in simulated laboratory conditions, the fate of various plastics fragments (Polystyrene, Polypropylene and Polyactic Acid) immersed in fresh water and UV irradiated. We worked either with real wastes (from post-consumer sector) or with model polymers totally free of additives. The polymers were chosen for their different physical properties. Polystyrene behaves like a glass (Tg = 104 °C) at the temperatures of use, which is not the case of the PP (Tg = 0 °C). Finally, PLA can start hydrolysis reactions.

During the exposure time, solids and liquids (a small volume of water) are taken for analysis (chemical and biological). The main result is that in all cases there is a formation and leaching of short chain (1C, 2C, 3C) carboxylic acids (acetic and formic acids, lactic and glycolic in the case of PLA) all known to be markers of polymer degradation. In the absence of light no transfer of any acid in the liquid is recorded.

TU193 Characterization and Environmental Risk Assessment of Polymeric Cosmetic and Personal Care Ingredients

J. Davies, Personal Care Products Council / Science

Polymers have been developed to perform a variety of functions that are central to modern living. Cosmetic and personal care products (CPCPs) contain a wide array of polymeric ingredients which are identified by the International Nomenclature of Cosmetic Ingredients (INCI). An INCI name often represents several polymers with different physical and chemical properties. This often leads to one INCI named polymer existing as several physical forms. For example, polyethylene can exist as a solid plastic microbead or a non-plastic wax thickening agent. The presence of polymers in the environment, particularly plastics, is of growing concern, yet relatively little is known about the environmental risk these materials may pose or how this can be assessed. The CPCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physchem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and thus the highest potential to contribute to environmental litter. Toxicity to fish is that in exposure and hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physchem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physchem properties to methods for assessing polymers. Depending on a polymer’s properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by USEPA) or use of novel methods. The work presented provides a scientifically robust approach for accurately assessing the impact of polymers in the environment.

TU194 Toxicological effects of irregularly-shaped and spherical microplastics in a marine teleost, the sheepshead minnow (Cyprinodon variegatus)

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Increasing worldwide contamination of the marine environment with plastics is raising public concern of potential hazards to microplastics to environmental and human health. Microplastics formed by the breakdown of larger plastics and thus are prioritized for assessment because they are routinely detected in the aquatic and marine environment and thus have the highest potential to contribute to environmental litter. Toxicity to fish is that in exposure and hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physchem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physchem properties to methods for assessing polymers. Depending on a polymer’s properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by USEPA) or use of novel methods. The work presented provides a scientifically robust approach for accurately assessing the impact of polymers in the environment.

TU195 Assessment of the microplastic contamination in sediments from the French Atlantic coast

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The ubiquitous presence of MPs has been demonstrated by scientists for recent years. They are detected in all environmental compartments: air, freshwater, aquatic organisms and particularly in marine ecosystems. Sediments are known as the most important compartment in the aquatic environment. Thus, the aim of this study was to assess the MP contamination in sediment from the French Atlantic coast. Sediments were sampled at three locations (Pays de la Loire region, France) and in two seasons: October 2015 (beginning of autumn) and March 2016 (beginning of spring). Firstly, different protocols (with or without digestion step) were tested according to the literature and the most appropriate was validated spiking 25 g of sediment samples in triplicates with 4 different MP types: polyethylene (PE), polypropylene (PP), polypyrrol chloride (PVC) and polyethylene terephthalate (PET). MP extraction from sediments was performed using milliQ-water combined with centrifugation technique. After a filtration step, MPs were detected and identified directly on the membrane filters using µFTIR spectroscopy in reflection mode. Then, a test was performed in order to determine the replicate number required to obtain a 100% probability representativeness of the whole sampled sediment. For the sediment collected in the field, MPs were found in each location and for each season. Average levels ranged from 38 (±46.72) to 102 (±105.37) MP per kg of dry sediment (N = 10; 250 g). Ten different compositions of MPs were defined by µFT-IR with a high proportion of PE and PP, 38 and 23% respectively. Five MP types (PE, PP, PVC, polystyrene and polyester) represented more than 90% of MPs. Interesting information of MP characteristics supported the explanation of the source and also the long-time passed in marine environment. None of significant differences were found among six sample groups. This work provides the first dataset on the level of contamination in sediments from the French Atlantic Coast.

TU196 Challenges in implementing legal frameworks for assessing water quality: the cases of the EU and Swiss approaches

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Human activities have a great impact on river quality. Monitoring programs show that multiple chemicals are present in water and that physiso-chemical properties and runoff/dissolution capacity of rivers evolve due to climatic changes. These changes can affect the aquatic ecosystems as well as the amount of useable water. It is therefore crucial to evaluate the state of river systems using a holistic approach. The European Commission established a framework to highlight rivers’ ecological deficits and to enhance regional or local water management plans. In Switzerland, such a framework is currently under development. In this study, we compared both procedures and implemented them in a Swiss catchment dominated by agricultural activities. The goal was to identify challenges linked to the application of these approaches. Both frameworks highlight that no section of the river meets a good environmental state and that the latter deteriorates as tributaries and wastewater discharge flow into the main riverbed. Chemical issues and water quality changes due to hydro-climatic variations and management strategies were also pinpointed. Both frameworks are thus able to highlight the main problems of the river and are consistent with each other. They are thus useful tools to survey the spatial and temporal evolution of rivers quality. However, several challenges remain, especially regarding the strategies to monitor and analyze chemicals, the definition of target values and conditions, the evaluation and integration of human-induced-pressures, and the overall evaluation of the rivers state.

Development of integrated indicators is seen as a potential solution to explore river health and to provide efficient restoration measures by water managers.

TU197 Updating the Environmental Quality Standards for the EU priority substance chlorpyrifos

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Chlorpyrifos (CPY) is widely used as an active ingredient in insecticides. Since 2005 CPY is a priority substance under the EU Water Framework Directive (WFD) with an AA-EQS of 0.033 mg/L and a MAC-EQS of 0.1 mg/L. The aim of this study was to update the EU Quality Standard (EQS) based on the current data and the WFD method for EQS derivation published in 2011. Both AA-EQS and MAC-EQS decreased by more than one order of magnitude. The original AA-EQS was not derived based on available chronic ecotoxicity data but was set as MAC-EQS divided by a factor of 3, while the revised value of 0.00046 mg/L is based on a NOEC for A. bahia taken from the EESA authorisation dossier and was an assessment factor (AF) of 10. The original MAC-EQS was derived from mesocosm NOECs using an AF of 1. The revised MAC-EQS of 0.0044 mg/L is based on an HC5 from a species sensitivity distribution (SSD) for crustaceans and insects using
the lowest effective AF of 5. The SSD reveals branchiopod and amphipod being the most sensitive taxonomic groups for CPY. A re-evaluation of old and new mesocosm data showed that using the available mesocosm data for EQS derivation is likely to be underprotective for amphipod. The original EQS dossier from 2005 contains no specific EQS derivation for sediment. It was concluded that “Protection of sediment [is] covered by the QS referring to the pelagic community”. The data sets were collected on a chronic basis for sediment monitoring which results in different effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data show that the amphipod H. azteca might be as sensitive to CPY as the insects C. riparius and C. tentans but chronic data are available only for insects. The resulting sediment EQS\text{sat,AF} of 0.32 µg L\text{}^{-1} dw was derived by applying an AF of 100 on the chronic NOEC for C. riparius. For comparison, also the equilibrium partitioning method was used to derive an EQS\text{}_{\text{bioavailable}} from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQS\text{}_{\text{bioavailable}} of 0.016 µg kg\text{}^{-1} dw. Without this AF, the EQS\text{}_{\text{bioavailable}} would be in the same order of magnitude as the calculated EQS\text{}_{\text{sat,AF}}. Based on our EQS update we strongly recommend to revise the current EQS values for CPY.

TU198
Lead exposures in European Freshwaters: are they a risk? A regulatory assessment accounting for bioavailability
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Lead (Pb) is a chemical for which one EQS has been set and is applied across all countries in the European Union. Using Pb, a user-friendly tool based upon Biotic Ligand Models (BLMs) was used to account for bioavailability, along with the current European Water Framework Directive lead dissolved organic carbon correction (DOC-WFD) approach. The outputs from both approaches were compared to the Biotic Ligand Model (BLM), the final tier in the tiered approach. Lead exposures are relatively low across all regulatory datasets and FOREGS. At Tier 1, only 3.9% of sites and samples assessed have a dissolved Pb concentration of greater than or equal to the EQS\text{}_{\text{bioavailable}}. The greater frequencies of such sites are found in the Alps and Norway. The lowest Pb concentrations in the world sample to a bioavailability-based concentration to be compared to an EQS\text{}_{\text{bioavailable}}. In Tier 1 measured concentrations were compared against the EQS\text{}_{\text{bioavailable}}. In Tier 2, Pb-EQS were applied for regulatory purposes. The dominant approaches to deal with survival data are descriptive, focussing on standardised tests and simple summary statistics (such as the LC50). Such descriptive methods ignore the fact that lethal effects develop over time, thereby leading to biased assessments and precluding useful predictions to untested exposure scenarios. Making sense of toxic effects over time requires mechanistic models, and, more specifically, the explicit consideration of toxicokinetics and toxicodynamics (TKTD). For the endpoint survival, almost all existing TKTD models can be viewed as special cases of a mechanistic framework: GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has subsequently gained a large user community. Furthermore, the model is receiving increased interest from the regulatory field as it is expertly suited for the analysis of survival data, and for extrapolation across different exposure scenarios. With the increasing interest in GUTS, and the increasing interest in good-modelling practice, it is time for a more detailed treatment on this model framework. In a CEFIC-LRI funded project, we have prepared an extensive e-book on GUTS (which will be available for download, free of charge, January 2018). The book contains a detailed description of the model framework (concepts, underlying assumptions and mathematics) and its historical roots, as well as worked-out case studies, guidance for users of the model (or its results), and the results of a ring test for a range of software implementations. This book is the standard work on GUTS modelling, and the e-book format allows the contents to be kept up to date with the major novel developments in this area.

TU202
Dose response modelling in aquatic and terrestrial effect models
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In recent years mechanistic effect models including GUTS and DEBTox have been successfully used in the aquatic and terrestrial risk assessment of pesticides. These models offer the advantage that results from laboratory studies, usually conducted with constant exposure, can be extended to time variable exposure, which is more typical under field conditions. At present these models consider a threshold beyond...
which effects start to appear. Once this threshold is surpassed the amount of effect affects is calculated using a linear regression, i.e. effects increase linearly with increasing concentration. In other areas of the risk assessment dose-response modelling and the derivation of reliable dose-response curves has received much focus (see e.g. the new EFSA guidance on benchmark dose modelling). Therefore, it is investigated in the present study if these models can be improved by considering more typical dose-response curves, which are often sigmoidal shaped. It is investigated whether the specific shape of a dose-response curve affects the outcome of an assessment and how the magnitude of predicted effects is affected.

TU203 Investigating toxicokinetics of emergent pollutants (PFASs) in the common sole (Solea solea) from in situ measurements and experimental data on PCBs within a DEB-based modelling approach.
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In the context of global change, developing mechanistic tools integrating the influence of environmental factors on toxicants bioaccumulation dynamics is required, as organisms will face unprecedented conditions. Mechanistic models based on the Dynamic Energy Budget (DEB) theory are relevant to predict individual and population responses to these factors and habitat changes. The main objective of this project is to investigate toxicokinetics (TK) of PFASs in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France). In a highly fluctuating environment, our goal was to extract information from the large variability observed in the measurements for several polychlorobiphenyls (PCBs) and PFASs. First, we designed environmental scenarios and prioritized environmental stressors using a mechanistic model calibrated for CB153 thanks to experimental data. As CB153 is poorly biotransformable in fish, its bioaccumulation in juveniles mainly relies on the ingestion of contaminated food. Further, we considered this congener as an additional tracer of potential prey residue in the wild. Indeed, diet reconstruction from stomach contents and isotope data provided us with contrasted pictures. We predicted that sole growth and reproduction are strictly linked to changes in food availability and quality. Currently, DEB modelling allows including adverse effects (DEB-tox), often based on internal concentration. However, for emerging compounds like PerfluoroAlkyl Substances (PFASs), toxicokinetics calibration is a challenge as their properties are not fully characterized yet and experiments are scarce. We here present the results of a research project at investigating toxicokinetics of (TK) of PFASs in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France).

TU205 Grey seal physiology and environmental change
J. Desforges, Aarhus University (AU) / biocience; G.M. Marques, University of Lisbon; K. Kauhala, Natural Resources Institute Finland Luke; K. Harding, University of Gothenburg Sweden

Marine mammals are considered as sentinel species for marine ecosystem health. In the Baltic, grey seals (Halichoerus grypus) can serve this purpose as they are top predators and have shown to respond to anthropogenic and environmental stressors over the past decades. These stressors can influence the physiology and health of grey seals, ultimately leading to individual and population level consequences. Acknowledging the need for mechanistic understanding of stressor effects, we have developed a full lifecycle bioenergetics model for Baltic grey seals using Dynamic Energy Budget (DEB) theory. We use the comprehensive information available on the physiology of Glycogen activity, long-term exposure (pw) and reproduction to parameterize and validate our model. Our model accurately predicted grey seal ontogeny and lifehistory traits, providing one of the first full descriptions of mammalian development in DEB. Recent reports have indicated that climate change effects on sea ice and food web dynamics have impacted grey seal condition (i.e. blubber thickness). We use our model to explore these relationships and confirm that specific seal health conditions in the Baltic is adherent to climate changes.
significant higher than that of MAP (0.086±0.018 ml g−1 (p < 0.001), and the uptake rate constant of MDP 0.128±0.001 ml g−1 h−1 was also significantly greater than MAP 0.086±0.001 ml g−1 h−1 (p < 0.001), it revealed that Cu was likely to bind on MDP in the low exposure concentration than that of MAP. This study concluded that Cu tend to accumulate in MDP, then may cause less toxicity to tilapia. Keywords: Copper; bioavailability; transport protein; subcellular partitioning

TU208

Relationships between subcellular metal partitioning and biomarkers of effects in white suckers (Catostomus commersonii) exposed to an environmental metal gradient

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Discharges from mining operations may lead to metal accumulation in freshwaters. Once metals enter cells, they can bind to sensitive components and cause deleterious effects. Moreover, metals can also be detoxified by binding to nucleophiles designed to sequester them, limiting their toxicity. The objectives of this study were (i) to assess the subcellular distribution of metals and metalloids (Cd, Cu, Se and Zn) in livers of white suckers exposed to metal-mining effluents, and (ii) to investigate the links between the binding of specific metals to particular subcellular fractions and physiological effects. To this end, mature male and female fish were collected in three lakes downstream from a metal-mining effluent and one lake in a reference area. Subcellular partitioning among putative metal-sensitive fractions (MSF) and biologically detoxified fractions (BDM) in livers was determined after differential centrifugation and heat-denaturation steps. In parallel, a suite of biomarkers was investigated ranging from general indicators of energy accumulation to specific indicators of oxidative stress and metabolic or bio synthetic capacities. Total hepatic metal concentrations were significantly higher in exposed fish than in reference fish, with Cd (x10) and Se (x10) being accumulated the most. No differences between sexes were observed. Subcellular partitioning of metals was similar among areas but specific to metals; over 70% of the Cd burden was found in the heat-stable cytosolic proteins fraction, which includes metallothionenin. In contrast, the largest contributors to the total Se liver burden were the potentially metal-sensitive heat-denaturable proteins fraction (=35%), and the organelles fraction (=30%). These results suggest that Cd was well detoxified and regulated by white suckers, whereas the presence of relatively high Se concentrations in the MSF suggests that exposed fish were likely subject to stress. Principal component analysis showed that increasing [Se] in all of the fractions was strongly correlated with lower fish condition and associated with higher serum and liver protein concentrations, a trait associated with higher oxidative stress. Finally, this work will contribute to advancing our understanding of the toxic modes of action of metals in aquatic organisms and our capacity to monitor the risk for fish inhabiting metal-contaminated environments.

TU209

Development of an adverse outcome pathway for acetylcholinesterase inhibition in zebrafish (Danio rerio)

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Acetylcholinesterase is a neurotransmitter that is important for a broad range of processes in the body such as muscle activation. Acetylcholinesterase (AChE) is an enzyme that hydrolyzes acetylcholine in order to eliminate it from the body, and when AChE is inhibited acetylcholine levels increase. Excess acetylcholine at cholinergic synapses overstimulates muscarinic- and nicotinic-type receptors. These receptors are found in most organs of the body, thus multiple adverse outcomes may result. Moreover, a wide variety of chemicals including organophosphates, carbamates and some high nitrogen compounds, can inhibit AChE. Thus, the impact of AChE inhibition is large, yet relatively little research has been focused upon developing related adverse outcome pathways (AOPs) or a network for this molecular initiating event. This presentation focuses upon the construction of adverse outcome pathways that result from AChE inhibition in zebrafish (Danio rerio). We performed a comprehensive review of the literature to identify studies and datasets that could be used to construct an AChE AOP. Adverse outcomes include seizures, impairment of the retina architecture and behavioral changes. Preliminary AOPs for these outcomes will be presented with references to the studies that support the AOP, and identification of data needed for quantitative AOP development.

TU210

Development of a Novel Quantitative Adverse Outcome Pathway Predictive Model for Lung Cancer

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Traditional methods for carcinogenicity testing are resource-intensive, retrospective, and time consuming. An increasing testing burden has generated interest in the adverse outcome pathway (AOP) concept as a tool to evaluate chemical safety in a more efficient, rapid and effective manner that better directs resource utilization. A central premise of the AOP concept is that pathway progression from the molecular initiating event (MIE) implies a definable "response-response" (R-R) relationship exists between each key event (KE) that drives the pathway towards the adverse outcome. Computational description of these R-R relationships in a quantitative AOP (qAOP) enables dose-response consideration of probabilities and uncertainty, as well as flagging of special at-risk populations or sentinel species. The qAOP also provides a platform to utilize early genomic and in vitro data streams for rapid, high-throughput-intensity prediction as well as the dose toxicity regressions that inform the level of risk. This poster describes a novel AOP/qAOP for lung cancer in the mouse from the MIE of CYP2F2-specific formation of reactive metabolites, advancing through KE for protein/nuclear acid adducts, diminished CC10 capacity and hyperplasia of CC10 deficient Clb cells, and culminating in the adverse outcome of mixed-cell cancer. The AOP is independent of route of exposure and grounded in overlapping mechanistic events for naphthalene, styrene, ethyl benzene, isoniazid and fluensulfone in the mouse. The qAOP modeling is supported by defined mechanistic relationships and quantitative data (PB-PK, dose-response and time-course) from archival data in peer-reviewed literature. Findings will include evaluation of data supporting the cancer qAOP, suitability for characterization of R-R relationships, and identification of data gaps or additional research as required. This approach supports international efforts on use of quantitative effect thresholds for adversity predictions and incorporation of novel data streams into the cancer risk assessment process. This abstract does not necessarily represent the views or policies of the U.S. EPA.

TU211

A combined PBTK and qAOP-modeling approach to assess the impact of dioxin-like compound (DLC)-induced embryotoxicity on recruitment failure in European eels

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The panmictic stock of the European eel (Anguilla anguilla) has seen a dramatic decline over the past several decades, and declines in recruitment as a result of maternally transferred contaminants has been proposed as one of several potential causes. In particular, dioxin-like chemicals (DLCs) have been identified as a class of chemicals of great concern for both European and American eels (Anguilla rostrata). DLCs bioaccumulate, are highly embryotoxic in many species of fish, and maternally transferred in artificially mated eels. However, to date researchers have been unable to locate or identify specific relationships between those levels in the natural spawning grounds in the Sargasso Sea. As a result, accurate embryotoxicity data to identify the potential causative chemicals are unavailable. Therefore, this study aimed to (a) parameterize a physiologically-based toxicokinetic (PBTK) model for European eels to account for the impact of changes in physiology that result from sexual maturation and migration on toxicokinetics, and (b) to couple this model with a quantitative adverse outcome pathway (qAOP) for activation of the aryl hydrocarbon receptor 2 (AHR2) of fishes to predict early life stage mortality of eels as a result of exposure to maternally transferred DLCs. The PBTK model was used to kinetically predict the redistribution of DLCs within the body of female eels during migration, and ultimately the concentration in gonads and eggs. A single qAOP was described previously linking activation of species-specific AHR2 in vitro with gene expression. The AHR2 pathway in zebrafish (Danio rerio) cells with embryo lethality across nine species of fishes exposed to DLCs. To this end, AHR2 was cloned from European eel and used to predict eel-specific relative potencies of five DLCs representing congeners measured at among the greatest concentrations in gonads of eels. Using this data, mortality of early life stages of eels was estimated based on the internal concentrations predicted by the PBTK model. Our integrated PBTK model and qAOP approach will ultimately shed light on the question whether early life stage mortality induced by exposure to DLCs has the potential to significantly contribute to the observed decline in recruitment of eels.

TU212

Salmonid pituitary cells as a test system for identifying endocrine disrupting compounds

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The pituitary gland is a key endocrine organ, producing two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which regulate gonadal development, sex steroid synthesis and gamete maturation. Despite its central role in regulating reproduction, there are limited data on impacts of endocrine disrupting chemicals (EDCs) on the pituitary gland. We have previously observed that waterborne exposure of previtellogenic coho salmon to 17-ethynylestradiol (EE2) causes widespread effects on the pituitary transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (FSHβ) mRNA levels.

These results motivated us to expand our studies by developing an in vitro test system using saline and larval coho salmon pituitary cells. We have developed two in vitro assays using saline and larval coho salmon pituitary cells. These assays are useful for detecting and characterizing endocrine disruptors which can cause changes in the pituitary transcriptome. These changes are useful for detecting the presence of endocrine disruptors in the environment.

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end-of-life (EoL) processes, this is increasingly relevant when comparing different electrochemical energy storage technologies. Thus, a thorough modelling of the EoL phase can be considered mandatory for a well-funded assessment. For evaluating this aspect we expand existing LCA studies on stationary batteries by a tentative modelling of their EoL processes (recycling) and compare the results. Three different battery technologies are considered for this purpose, an LFP-LTO battery (rack-mounted setup), a hybrid aqueous battery (AHBB) and a Li-ion redox flow battery (VRFB), all with the same capacity.

The results show that considering the end-of-life stage actually does change the outcomes of the results significantly and that cradle-to-gate assessments are not appropriate for comparing very different battery technologies. Highly integrated batteries like the LIB have advantages under a cradle-to-gate perspective (higher energy density and thus lower material demand per provided capacity), while less integrated systems can have significant advantages when it comes to recyclability. The AHBB and VRFB are easy to dismantle and all major components can be recovered by mechanical dismantling on a macro-scale. The highly integrated LIB require complex processes and obtain a commingled fraction of micro-size particles that are difficult to separate and require significant process inputs while only recovering a fraction of the materials originally contained in the batteries. This can change the picture fundamentally towards an advantage of technologies easy to dismantle on macro-scale (AHBB and VRFB) in comparison with highly integrated cells (LIB). Thus, design for recyclability is highly important in terms of future circular economy and might easily outweigh the possibly reduced energy density or lower performance.

TU216 Battery recycling efficiencies and their influence on the life cycle impacts of batteries

K. Boonen, A. Van der Linden, VITO

The EU Batteries Directive sets the minimum recycling efficiencies for waste batteries as a percentage of their average weight. In the light of the circular economy, it may be argued that, in addition to the quantity, it is important to consider the specific materials that are recycled, the quality of the recycled fractions and their potential use. The Public Waste Agency of Flanders (OVAM) asked VITO to assess the effect of these factors. In this study, the environmental impact of the end of life is compared for different battery recycling routes. Furthermore, the impact of the rest of the life cycle of disposable and rechargeable batteries is calculated to put the impact of the end of life into perspective. A number of potential improvement options, such as a higher collection rate, higher functional recycling and a shift to different types of batteries, are evaluated.

TU218 New and Reconditioned Electrical and Electronic Equipment. How does the environmental performance? M. Pini, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering; P. Neri, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering DISMI; R. Gambirini, B. Rimini, F. Lolli, University of Modena and Reggio Emilia; A. Ferrari, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering The scope of this study, carried out within the LIFEL21 ENV/IT001058 WEEEModels, was to compare the environmental performance of the life cycle of new electrical and electronic equipment (EEE) and the reused one through the Life Cycle Assessment methodology. Both attributional and consequential LCI (Life Cycle Inventory) models have been implemented. The environmental impact of the rest of the life cycle of disposable and rechargeable batteries has been considered for each WEEE group, assuming that it generates the same environmental damage of the other products belonging to the same category. In particular, the following representative products have been selected: refrigerator (R1), washing machine (R2), cathode ray tube (CRT) (R3), laptop (R4) and fluorescent lamp (R5). In addition, lower performance of reconditioned EEE has been taken into account. Different set of replaced components have been evaluated in order to understand which determines the best solution. Scenario A represents the set of replaced components, which damage more frequently. Scenario B is just an alternative set of replaced components. The environmental comparison between new and reused EEE, adopting attributional LCI modelling, showed that Scenario B produces a damage decrease for all WEEE categories. Moving on the consequential LCI modelling, the environmental comparison highlighted for both scenarios a considerable damage reduction for the reused EEE respect the new one. Furthermore, for the reused R1, R2, R3 the analysis of results carried out environment credits. This is due to the avoided burdens associated to the manufacturing of the new EEE, since the system boundaries have been enlarged under Scenario B considering the avoided production of the components. Attributional and consequential LCI modelling performed different LCIA results. Following the methodological guidance for the identification of the most adequate LCI modelling framework presented by Laurent et al., 2014, it would recommend to adopt consequential LCI modelling. But we suggest to LCA practitioner to focus also the attention on the request of who commissioned the project, which often in the waste field are local administrations. Generally, they wants a snapshot of the real effects that waste management policies provoke on human health and environment. For this reason, attributional LCI modelling would be the proper LCI modelling to achieve this scope. Considering this LCI modelling the Scenario B determines the
TU219 The impact of European consumption of household appliances: insights from the LCA of efficiency measures and expected trends

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Household appliances are an important contributor to the overall impact generated by European citizens’ consumption of products. In 2010 the energy-related products covered by the Ecodesign directive responsible for 53% of total EU-28 greenhouse gas emissions. The aim of this contribution is to report on the results of the Life Cycle Assessment (LCA) of future scenarios of the European consumption of household appliances in the residential sector. The consumption is a Basket of Products (BoP) owned by an average European citizen. The BoP baseline consists of a process-based LCI model for a BoP that represents the most relevant household appliances in terms of energy consumption and market share: dishwasher, washing machine, drying machine, air conditioner, refrigerator, TV screen, computer, lighting, cooking appliances. A number of scenarios have been tested, covering the various life cycle stages including scenarios on the use phase, the waste collection, the electricity mix used. An overall scenario covering the design options for products energy efficiency and expected trends in purchase and user behavior has been calculated and compared with the baseline. The baseline has been modified (with LCID impact assessment methods) confirmed the well-known relevance of the use phase of energy-related products, where the efficiency of products and consumer behaviour appear to be the two factors determining the BoP impact. Results of the scenarios assessed show for most of the categories a reduction of the overall impact compared to the baseline scenario. The reduction is more important for categories like e.g. GWP (due to the improved energy efficiency of the products) and the emission of nuclear and chemical plants in Europe) and AP (in this case, the reduction of the amount of coal-based electricity leads to reduced releases to the atmosphere of those substances contributing to AP). Due to the expected increase of the number of devices per person in the future, some of the impact categories – namely HTP, FETP, LUC and FRD – show a higher potential impact in the scenarios than it is in the baseline. Obtained results show clearly that just heading for more efficient devices is a necessary, but not yet a sufficient condition towards more sustainability; we as a society have also to re-evaluate the way we acquire (more and more) such devices and are spending more and more time behind them – here some limitations may make sense.

TU220 Assessing economic and environmental effects of product replacement program using dynamic discrete choice model: As a case study of “home appliance eco-point system” in Japan

D. Nishijsima, National Institute for Environmental Studies; S. Kagawa, Kyushu University; M. Oguchi, K. Nansai, National Institute for Environmental Studies In evaluating environmental burdens from consumer durables, product lifetime is a key factor and most of the previous studies used average lifetime or lifetime distribution with a focus of engineering durability (Müller 2006; Kagawa et al., 2011; Nishijsima, 2016). These product lifetime modelling techniques did not explicitly treat a relationship between product replacement and consumer’s behavior. Whereas, the product replacement modelling techniques based on the economic maximum utility theory have been developed in economics and marketing fields (Schiraldi, 2011; Melnikov, 2013). It is beneficial to apply the economic product replacement models to environmental research. This study attempts to use the product replacement model for evaluating economic and environmental effect of polices for consumer durables. As a case study, we focused on air conditioners and analyzed the economic and environmental impacts of “home appliance eco-point system” in Japan which was conducted during a period from May 2009 to March 2011 for encouraging consumers to replace their own products with new ones. Following the proceeding studies (Rust, 1987; Gordon, 2009), we constructed the product replacement model of air conditioners in Japan by Bellman equation and a dynamic discrete choice model. We also estimated the logarithmic utility function with the maximum likelihood estimation. We used the annual sales and replacement data of air conditioners during 1993 to 2015 (The Japan Refrigeration and Air Conditioning Industry Association; The Japan Electrical Manufacturers’ Association) and replacement and running cost data during the same period (Agency for Natural Resources and Energy of Japan; The Japan Refrigeration and Air Conditioning Industry Association). Using the estimated product replacement model, we analyzed the impact of “Home appliance eco-point system” on the CO2 emissions and economic output by input-output framework. Through the results, we not only evaluated how effective the system was for reducing CO2 emissions and stimulating economy in Japan, but discuss how we could improve the system for obtaining more economic and environmental benefits.

TU221 Economic lifetime, hazard functions, and car inspection system

Y. NAKAMOTO, S. Kagawa, Kyushu University

Under the Paris Agreement adopted at COP21, Japan set itself a target of reducing its territorial greenhouse gas emissions by 26% (relative to the 2013 level) by 2030. To further reduce emissions in the transport sector, the government has set up both a technology policy and a demand policy, to try to improve the fuel economy of new vehicles and increase sales of next-generation motor vehicles as a proportion of new vehicle sales, respectively [Ministry of Land, Infrastructure, Transport and Tourism, 2017]. In by assessing and estimating the economic lifetime of vehicles on consumer behavior that maximizes utility level over time, we were able not only to specify the replacement purchase rate on a dynamic discrete choice model but also to quantitatively analyze the environmental impact of changes in consumer behavior due to the adoption of policies because a motor vehicle inspection dummy, maintenance and repair costs, and new vehicle replacement purchase costs are explicitly included in the utility functions at the time of purchase and vehicle replacement. ’In this study, we developed a DDC model to estimate car replacement purchase rates based on consumer behavior aimed at maximizing utility levels over time. By combining replacement purchase rates specified from source data with life-cycle CO2 emissions analysis, we demonstrated the impact of Japan’s car inspection system on CO2 emissions derived from cars. The parameter estimate results obtained from our DDC model are robust, showing that car owners behave with a forward-looking perspective. In addition, it is clear that offering subsidies for car inspection costs can be expected to have a substantial effect on cutting CO2 emissions associated with the transport sector because it would dampen car replacement purchase behavior and thereby increase the average economic lifetime of cars. In the results of this study show that revising Japan’s car inspection system has the potential to cause a major turnaround in vehicle replacement purchase behavior contributing to cutting CO2 emissions. However, in practice, completely scrapping the current car inspection system would be very difficult. This is because, although abolishing inspections would relieve car owners of a painful cost benefit, it also put the safety of car operation at risk, due to the failure to detect problems that a car inspection would ordinarily detect.

TU222 Li-S batteries for electric vehicles, challenges for circular economy objectives

C. Benveniste, C. Corchero, IREC; B. Amante, Universitat Politècnica de Catalunya

The continuous and planned increase of the electrification in the transport sector is one of the main drivers of advances in energy storage for electric vehicle (EV) propulsion and present technological challenges to achieve the expected requirements. The implementation of the EVs on our roads remains a challenge and is below expectations foreseen. The elevated costs of the batteries and thus the EV cost, refrain the massive depletion of this technology. With the aim of reaching a field where EVs are normal anddue to the short term, it is necessary to investigate new materials and configurations of EV batteries. To this end, lithium-sulfur (Li-S) batteries are the closest battery technology capable of meeting these expectations. Although Li-S can overcome the technical issues, this solution still needs to demonstrate how the socio-economic-environmental barriers associated are solved, above all when considering their fitting in a circular economy society. There are no clear evidences of the environmental benefits due to the use of Li-S batteries as an alternative to Li-ion batteries. Moreover, there is still unclear of how these batteries should be treated at their end of life with the aim of recovering the maximum amount of valuable materials. This study focuses on the methodological design to analyze the environmental and social aspects related to Li-S batteries using LCA perspective in a circular economy context. This research has the following objectives: 1) To evaluate their environmental profile; 2) To identify their potential possible use in a second life, once they cannot be used in an EV (e.g. their use in stationary applications); 3) To evaluate the associated environmental impacts and potential benefits due to material recovering using batteries recycling options. These objectives present a considerable number of challenges due to the lack of data in the Li-S data inventory collection, the uncertainties due to the feasibility of using them in second life and the lack of examples to analyze economic and environmental benefits of designing a customized recycling process. For this reason, the aspects covered by this study are extremely relevant in the frame of considering Li-S batteries technology as a suitable system within the objectives of a circular economy. This research is being carried out within HELIS Project. This project receives funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement No 666221.

TU223 ATISOL C2C - Life cycle assessment as a tool for the ecoscading of a “vapur and air barrier membrane - insulator” system, in a cradle to cradle approach

A. Léonard, Liège Université / Chemical Engineering PEPs; M. Getlicherman, Derbigum; B. Colson, Sioen Felt &

The ATISOL C2C project focuses on the circular economy of the Li-ion batteries. To this end, it is necessary to investigate new materials and configurations of EV batteries. To this end, lithium-sulfur (Li-S) batteries are the closest battery technology capable of meeting these expectations. Although Li-S can overcome the technical issues, this solution still needs to demonstrate how the socio-economic-environmental barriers associated are solved, above all when considering their fitting in a circular economy society. There are no clear evidences of the environmental benefits due to the use of Li-S batteries as an alternative to Li-ion batteries. Moreover, there is still unclear of how these batteries should be treated at their end of life with the aim of recovering the maximum amount of valuable materials. This study focuses on the methodological design to analyze the environmental and social aspects related to Li-S batteries using LCA perspective in a circular economy context. This research has the following objectives: 1) To evaluate their environmental profile; 2) To identify their potential possible use in a second life, once they cannot be used in an EV (e.g. their use in stationary applications); 3) To evaluate the associated environmental impacts and potential benefits due to material recovering using batteries recycling options. These objectives present a considerable number of challenges due to the lack of data in the Li-S data inventory collection, the uncertainties due to the feasibility of using them in second life and the lack of examples to analyze economic and environmental benefits of designing a customized recycling process. For this reason, the aspects covered by this study are extremely relevant in the frame of considering Li-S batteries technology as a suitable system within the objectives of a circular economy. This research is being carried out within HELIS Project. This project receives funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement No 666221.
the building is reduced, preventing condensation problems on the insulating material. Currently, the implementation of an insulation system combined with a vapor barrier presents three major problems: an important time for placing, a random durability in time (stability of tapes of junction, adherence to the existing walls, punching resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + reinforcement to the manufacturing process). This project is supported by the GreenWin Competition Chambers and subsidized by the Walloon Region (BE).

TU224

Life Cycle Assessment of Recycled Asphalt and Biomaterials for Road Pavements

A. Jimenez del Barco Carrion, The University of Nottingham; D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC

Taking stock of a circular economy within planetary boundaries: A multi-scale analysis through consequential LCA

H. Helander, A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy

Current institutional agendas are embracing the concept of “circular economy” (CE) in order to improve the sustainability of products and services and reduce the resource dependence. CE is applied through a broad range of strategies at various scales and is supposed to be comprehensively studied so as not to compromise the earth’s safe operating space. For this reason, consequential life cycle assessment (CLCA) provides suitable tools for understanding these changes. Our main goal is to create a methodological framework that enables the assessment of CE strategies across scales within the planetary boundaries. Two assessment levels will be considered, i.e., cities and products/sectors. The framework will be applied and tested through an analysis of time-based products (e.g., wooden houses, coat packaging and food waste), as well as on European cities applying CE-related strategies. At the city level, CLCA will be combined with territorial LCA to provide information on the environmental variations associated with local CE strategies. Thus, we might be able to determine the impacts of production and consumption activities that meet the needs of a city before and after the application of CE strategies. At the product level, case studies will evaluate different CE strategies such as eco-design, recycling and cascade use of resources. To address how sustainability changes with scale, sector-wide scenarios for different measures and changes in market shares will be constructed through a CLCA approach. Opportunities and challenges for the specific sector and context will be identified to include side effects and to ensure assessing realistic pathways. In this way, the framework adapts to the specific requirements of each sector, to interpret the results in relation to the safe operating space, the planetary boundaries will provide reduction targets. This will be done by following existing proposals on the integration of LCA results into the planetary boundaries approach. By combining a bottom-up CLCA approach with a top-down planetary boundary framework, we provide a method that can take stock of “real” environmental sustainability progress, at different scales and thereby help companies, cities and countries to understand the environmental implications of CE strategies. This might enable the integration of environmentally friendly CE initiatives into a variety of sectors and scales.
tool to direct future research. We performed the work using Simapro 8.0 software, method Recipe Endpoint (E) and the Ecoinvent 3.0 database. First, in drinking water production, flocculants are used to remove particles, natural organic matter (NOM) and metals (like iron) from water. The sludge formed can be hydrolysed again to recover iron for production of new flocculants. Our LCA study showed that flocculants obtained from iron sludge after HCl dosage have a significant lower environmental impact than commercial and recycled CaCo3. Recycled CaCo3 flocculants from iron sludge and water treatment purification or wastewater treatment looks promising and this LCA study underlined that technical research into the quality of the flocculants is justified. A sensitivity analysis indicated that the iron content of the sludge is strongly determining the environmental impact; thus indicating that different types of iron sludge should be considered for further research. As second case study, we investigated water management in shale gas production, since hydraulic fracturing technologies require significant volumes of water for well development and produce high volumes of wastewater with highly variable composition. Different treatment options for wastewater from shale gas production were compared in case 2. It is important to note that each process resulted in different effluent quality. Each process included a pre-treatment to consist of different air flotation and biogeneration, followed by either discharge directly to seawater, or treatment with vapour compression distillation (VCD) with water discharge to surface water and injection of the brine back to the deep underground formation. The LCA study on of shale gas waste water treatment indicated that more detailed information on the concentrations of compounds in the waste water is required. A technical research initiative was proposed to optimize compound removal from wastewater. In this study LCA has shown to be an effective tool to evaluate the direction of research within the waste sector, evaluate possibilities for resource recovery and determine environmental impacts of processes.

TU229 Closing the loop in a territory: LCA approaches to boost resource recovery M. Calvet, CETAUQA / MASE; M. Amores Barrero, CETAqua, Water Technology Centre; D. Marin, CETauqa, Water Technology Centre / Environment and Socioeconomics; M. Isasa, CETAqua Water Technology Centre / MASE; M. Termes, CETAUQA; M. Ruiz Mateo, CETauqa Water Technology Centre The concept of Circular Economy is widely extended in political and business agendas and so is the concept of “Closing the loops”. The idea that the value of materials and products should be maintained in the economy as long as possible and wastes minimised is understood and accepted. However, its implementation is bringing to the light questions as to which level to implement it (material, product, system, business and territory), which tools to use to decide on the most appropriate circular economy strategy to develop etc. The role of municipalities and wider geographical areas, act as accumulating resources that in the current linear model create negative externalities. However, these, waste and energy flows if managed in a circular system could be valorised bringing massive opportunities to all territorial actors. This paper explores the application of the Circular Economy in two different case studies in Spain (San Feliu de Llobregat an the Catalan Region) for which a methodology has been specifically created. The methodology is validated and its effectiveness demonstrated through the identification of more than 10 Circular Economy Opportunities in each case study. The role of LCA as a tool used in different stages of the Territorial Circular Model is explored i.e. at the data inventory gathering, resource flows analysis, assessment of the most appropriate circular economy strategies and the establishment of indicators to establish current levels of circularity and benchmarks. The need to develop a tool to assist in the data inventory gathering, data visualisation and material flows analysis to identify a greater number of circular economy opportunities is also highlighted. Conclusions of the research include the need to assess the identified opportunities from a technical, economic and social perspective. The importance of the development of an action plan to assist actors in the implementation of the preferred circular economy strategy is highlighted. Finally, the importance of monitoring of the assessed impacts of the strategy is emphasised.

TU230 Innovative method to optimize territorial organic waste resources G.C. Vega, The Technical University of Denmark (DTU) / Management Engineering; J. Sohn, The Technical University of Denmark DTU / DTU Management Engineering; M. Birkved, Technical University of Denmark / QSA Dept of Management Enng A truly environmentally sustainable bioeconomy requires integrative approaches for the design and development of industry to produce fuels and chemicals. A holistic approach is taken into account in order to arrive at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCAs of biotechnologies with analysis of producer territories in order to provide site specific recommendations that take into consideration different geographical and feasibility constraints, the present and future energy grid, and production capabilities. The authors posit that a multi-criteria approach, such as this, can prevent unforeseen burden shifting between environmental impacts while providing implementable decision support. Method: An LCA of various biotechnologies will be conducted with the aim to provide guidance for bioenergetic esdesign that would incorporate emerging biotechnologies and cascading products. Among these technologies, six pathways for anaerobic digestion (AD) and three different pathways to extract polyphenols will be assessed at the product level. At the territorial level a two-pronged approach will be used to achieve a representative data set for the territories, which will consist of material flow data from national and regional sources scaled down to the territory and individual producer data (primary where possible). Results: The feedback loop will be established between the modules of biorefinery assessment and the environment system at the level of the territory, in order to observe the effects of waste optimization on the territory. Results: The performance of the biotechnologies will very likely depend largely on energy consumption and the intended use of the new products viz. how the residual resources from wine production are used. At the territorial level the authors posit that local managerial practices, in terms of wine production will be greatly influential for global warming, eutrophication and resource depletion potentials. Fertilizer inputs, both mineral and organic, and pesticide use will very likely differ from territory to territory and will impact the above mentioned categories as well as toxicity related impact categories. Another important aspect will be the energy consumption of the territories and the influence of future energy grid greening on the future impacts of the technologies proposed today.

TU231 Environmental Benefits of a Circular Economy: Connecting Waste Type and Geographic Proximity R. Itten, K. Kelling, M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Science A circular economy is defined as transforming waste into resources. There is a plethora of waste and by-products that remain unused in the traditional linear industrial system. However, transformation from a linear to a circular system is challenging, limited by several constraints such as the availability of information on the specific composition of the waste, the availability in time and space of quality of waste as well as limited knowledge concerning the usability of such waste products. The goal of the SHAREBOX Horizon 2020 project is the development of a platform for the facilitation of synergies within the industry to enable a more circular flow of resources within the European processing industries. The SHAREBOX platform is a database of available waste and resources required by companies, enabling the transformation of waste to resources by matching supply and demand. The platform also serves as the first point of contact between different partners in a circular system. Furthermore, the platform enables the identification of new synergies overarching the different subsectors of the industries as well as optimal matching from the perspective of a circular economy. We analysed the implications of the transformation of different types of waste to resources when the industries are located in different geographic regions and using the life cycle stage of transformation. Waste PET can be transported up to 10 000 km by lorry and still provide a net benefit regarding greenhouse gas emissions due to circular use. However, in case of concrete, the results are very different. A net benefit only occurs if the additional transport distance compared to primary concrete is less than 5 km. Transformation from linear systems to circular systems can substantially reduce total resource consumption as well as emissions of the whole value chain and therefore contribute to a greener economy. However, matching industries for transformations leading to the substitution of primary materials is still a major challenge. In addition, the environmental benefits of the reduce of resources is limited by the life cycle stage of the transformation as well as by additional transportation that may be required. The completeness of the scope will be crucial for the assessment and generalisations overarching different types of waste remain challenging.

TU232 Evaluation of nutrients and energy recovery technologies through Life Cycle approaches M. Ruiz Mateo, CETauqa Water Technology Centre; M. Calvet, CETAUQA / MASE; S. Lopez, CETauqa Water Technology Centre / Sanitation; M. Isasa, CETauqa Water Technology Centre / MASE; Y. Lorenzo-Toja, CETauqa, Water Technology Centre; D. Marin, CETauqa, Water Technology Centre / Environment and Socioeconomics. Conventional treatments for wastewater treatment are characterized by a high energy consumption, mainly attributed to the oxidation (removal) of carbon and nutrients. In the current economic and environmental context, there is a necessity to find solutions and provide strategies and technologies to be able to change the current concept of Waste Water Treatment Plants (WWTs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the field of waste and resource management in order to prevent waste from the finite reserves of phosphate rock, that moreover, are located out of Europe. The LIFE RECOVERY project aims at demonstrating, by means of a prototype, the feasibility of a new wastewater treatment approach, based on energy and nutrients recovery. The process tested in the project is based on an initial pre-concentration step that promotes the biosorption process maximizing the biogas production. The effluent of the pre-concentration unit is the influent of a nutrient recovery unit based on adsorption in zeolites. The LIFE ENRICH project (Enhanced Nitrogen and Phosphorus Recovery from wastewater and Integration in the value CHain) goes a step further and aims at demonstrating the whole value chain for nutrient recovery
in wastewater treatment plants and their valorisation in agriculture through different approaches boosting a model based on circular economy. This study intends to evaluate environmentally and economically the innovative processes tested in the LIFE RECOVERY and LIFE ENRICH projects by comparing them to conventional schemes of wastewater treatment. To do so, Life Cycle Assessment (LCA) has been the selected methodology to quantify the environmental burdens of the innovative processes to the conventional ones. The latter are located: Vilanova WWTP and Murcia Este WWTP. Special focus has been put to impact on climate change, which is expected to be reduced thanks to the recovery of nutrients that could replace chemical fertilizers and due to the higher biogas production and its further valorisation. Life Cycle Costing (LCC) analysis has been undertaken in order to assess all relevant costs associated with the life cycle of both systems and to analyze cost efficiency and cost incurred (CAPEX and civil works) and operation and maintenance phase (OPEX costs e.g. energy, chemicals, transport) and is aimed to identify the most economic-friendly scheme.

TU233 Life Cycle Assessment of a novel process of polyhydroxyalkanoates production with waste and by-products from wine industry value chain A. Novi, Università di Bologna / Centro Interdipartimentale di Ricerca per le Scienze Ambientali; L. Vogli, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; S. Righi, University of Bologna / Physics; S. Macrelli, R. Conti, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; C. Samori, C. Torri, Università di Bologna / Dipartimento di Chimica G. Ciamician; E. Tagliavini, Università di Bologna / Dipartimento di Chimica G Ciamician Alma Mater Studiorum EU wine production accounts for some 60% of worldwide output, with France and Italy being the largest wine producer countries in the world (Gaeta and Corsinovi, 2014). The wine industry influences the environment with the use of soil, water, energy, fertilizers and pesticides. In addition it produces liquid and solid organic waste that has to be managed in the proper manner in order to minimize environmental impacts. In recent years, some innovative technologies have been proposed for the valorization of wine by-products and by-products (i.e. grape marc, grape seeds, vinification lees, etc.) (Devesa et al., 2011). VALSVOIT is a research project funded by Emilia Romagna Region (Italy) which aims to valorize wine industry by-products. Its focus is the development of an integrated strategy for the transformation of waste from the whole oenological supply chain into high added-value products such as polymers, base chemicals, and molecules for the nutraceutical, cosmetic and agrochemical industries. In this framework, a novel experimental process for the valorization of wine lees and sewage sludge is carried out. These wine residues are subject to anaerobic aceticogenic fermentation in order to produce volaraly fatty acids (VFAs), which in turn are used to feed a mixed microbial community (MMC) able to accumulate polyhydroxyalkanoates (PHAs) granules as carbon and energy intracellular reserve. The last step consists of PHAs extraction using dimethyl carbonate (DMC). Life cycle assessment is applied to calculate and compare the environmental impacts related to the production of one kg of PHAs, the evaluation of which is made using the SimaPro software. The environmental assessment of the system takes into account the following phases: extraction of the PHAs granules, extraction of the DMC, use of the by-products from wine lees and sewage sludge, valorization of the fermentation residues. Waste management is also considered in the environmental assessment of the system. The results show that the system is environmentally friendly scheme.

TU234 Environmental, social and economic challenges towards a bio-economy based: the STAR-ProBio project, Sustainability Transition Assessment and Research of Bio-based Products P. Rizzi, Università Statale di Milano / Dipartimento di Scienze dell’Agricoltura; S. Righi, University of Bologna / Physics; E. Merloni, University of Bologna; L. Summonte, University of York; L. Ladu, Technische Universität Berlin; A. Kontinas, Agricultural university Bologna / Physics; E. Merloni, University of Bologna; L. Summonte, University of Angola; S. González, SETAC Europe 28th Annual Meeting Abstract Book

TU235 Integration of a Colombian bio-refinery from industrial palm oil waste into the circular economy J. Torres, Universidad de la Salle / Grupo de Investigación en Gestión del Riesgo y Cambio Climático; I. Herrera, D. Garraín, A. Gamarra, CIMAT / Energy Dpt Empresa para el Desarrollo; C. Ullod, I. Apaza, SIAD/ENIET for Colombia

TU236 CRADLE-TO-GATE LIFE CYCLE ASSESSMENT OF BIOGAS PRODUCTION FROM PALM OIL MILK EFFLUENT N. Abdul Aziz, M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science

TU237 Challenges and open issues in assessing new technologies for circular economy solutions P. Masoni, Ecocoinnovazione srl / Sustainability Department; A. Zamagni,


Ecoinnovazione / LCA and Ecodesign Laboratory; D. Tonon, Ecoinnovazione srl
Circular Economy has become a concept quite known also within the public domain. It is a catchy term that puts together two words easily understood by everybody with a positive meaning. Moreover, it can be easily translated into simple rules/guidelines to follow to claim an improvement of our economy and its relationship with the environment, such as: recycle, avoid dangerous substances, extend the life of the products. However, the reality is more complex, and there are many factors to consider. For example, the recycling of waste streams in other life cycles does not come for free. For example, burden shifts from resource depletion to other environmental impacts are likely and common consequences. For this simple reason, life cycle assessment and life cycle sustainability analysis should be used to support the identification and understanding of the potential advantages of circular economy solutions, with the identification and management of the unavoidable trade-offs. In the case of innovative technologies developed to extract valuable substances from waste streams the complexities of the analysis are related to: scale-up from laboratory or pilot scale to full industrial scale; different possible industrial applications of the technology; a basket of diverse applications of the innovative semi-finished product/ingredient delivered by the new technology; diversity of the function of the technology; complex market of the substituted products, etc. This work presents and discusses how the above-mentioned challenges and open issues, with a focus on the diversity of the function of the technology, have been addressed in a specific case of an innovative technology to extract polyphenols from different waste streams. The presented example shows that the analysis can be rather complex due to the need of addressing different applications, identifying the boundaries and to the fact that the same technology can provide different functions according to the selected perspective. The oral presentation will detail how the main difficulties have been considered and addressed, such as the of scale-up, complex market of substituted products, different geographical location of the technology implementation. One key aspect is that the adopted perspective directly influences the results in terms of environmental preference of the innovative technology, and as such, the benefits of circularity solutions needs to be properly addressed and quantified, and are not inherently beneficial.

TU238
Circular economy: what does restaurant food waste generation and data allow companies to say?
R. Dagiliute, Vytautas Magnus University / Environmental Science Department; A. Mustekytė, Vytautas Magnus University Around 88 million t. of food is annually wasted in the European Union. According to FAO (2013), 31–39% of food is wasted at consumption level in developed regions. This wastage has an enormous negative impact on the global economy and food availability and courses major environmental impacts. EU programme “Towards a Resource Efficient Europe (COM (2011) 571) aims to change consumption and production patterns and achieve 20% reduction in the food chain’s carbon emissions. One key challenge is how this can be achieved, especially in restaurants, given that they have a considerable and relatively concentrated role in food waste generation.

TU240
Assessing life-cycle impacts of the sharing economy: how to account for behavioural changes?
I. A. Chaves, KU Leuven / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering; J. Eyckmans, KU Leuven / Faculty of Economics and Business
The sharing economy, facilitated by digital platforms, is expanding in to more and more areas of the economy and could help the transition to a more circular and sustainable economy. The a priori environmental benefits of sharing arise from providing wider access to goods with much less intensive use of the environment. In this study, the environmental benefits of sharing goods produced overall. Thus, in order to account for the impacts, goods must be assessed over their entire lifetime, particularly the manufacture and use phases. Life cycle assessment (LCA) is a tool that can be used to estimate such environmental impacts, but a comprehensive assessment should also include the variations of prices and behavioural changes of consumers to this new sharing marketplace. For example, sharing goods can lead to a rise in the demand of goods and intensity of use in many ways, with corresponding changes to market dynamics. This research consists of a review of studies into the sharing economy, and suggests how consequential LCA can be used to give a more detailed assessment of the environmental impacts. Particular attention is paid to how the behavioural changes in consumption should be accounted for in an LCA applied to the sharing economy.

Innovative techniques for enhancing and monitoring microbial activities for in situ remediation of contaminated sites (P)

TU241
Effects of plant growth and organic carbon addition on DDE degradation in soils
M. Cardoni, National Research Council of Italy / Water Research Institute; F. Mitton, University of Mar Del Plata; M. Di Lenola, National Research Council of Italy / Water Research Institute; L. Patroccoli, Water Research Institute-National Research Council / Water Research Institute; N. Aidomello, F. Sattoro, National Research Council of Italy / Water Research Institute; K. S. Miglioranza, University of Mar Del Plata / Laboratorio de Ecotoxicologia y Contaminacion Ambiental, Instituto de Investigaciones Marinas y Costeras; M. Gonzales, University of Mar Del Plata; P. Pressi, National Research Council of Italy (CNR) / Water Research Institute; R. Barra Caraccio, National Research Council / Water Research Institute
Since the use of DDT was banned in numerous Countries several years ago, owing to its high lipophilicity and persistence, this pesticide and its metabolites (p, p’ DDE and p, p’ DDD) are frequently found in the environment. Plant-assisted bio Remediation can be a promising clean-up technology to contaminated soil remediation; it relies on the synergistic action between plant rhizosphere and microorganisms to remove toxic substances. In this work, Solanum lycopersicum together with dissolved organic carbon were added to DDE-contaminated soil for bio Remediation purposes in greenhouse microcosms. The experimental set was
performed to assess the effectiveness on DDE biodegradation of tomato plant presence with and without the addition of two different DOC (with different humic substance composition). The pots were filled with contaminated soil (1 ppm of DDE) in presence/absence of tomato plants and watered with different kinds of DOC solutions; control soils (with/without plant and/or DDE) were also implemented. The plots were sampled after 40 days from DDE exposure. The effectiveness of the treatments on the microbial community and on DDE biodegradation ability were evaluated in terms of microbial abundance, viability, structure, dehydrogenase activity and DDE residual concentration. The results showed that the plant presence stimulated the overall soil microbial community activity but did not increase significantly the DDE biodegradation. The quality of the organic carbon in terms of fulvic and humic acids presence influenced differently both DDE degradation and microbial activity.

TU242 Soil microbial community associated to a poplar-assisted bioremediation study

Greenhouse experiments have been performed to test the capacity of the Populus sp. (clone Monviso) to grow on a PCB historically contaminated soil and to improve soil quality in terms of contaminant transformation and autochthonous microbial community abundance and activity. The experimental set-up consisted of pots filled with the contaminated soil and poplar cuttings, under the following conditions: microbiologically active soil (TMA), previously sterilized soil (TS), microbiologically active soil in hypoxia (TMAA). Moreover, non-planted soil was used as control. PCB concentrations in soil samples and plant roots were analysed 6 months and 12 months after the start of the experiments. At the same time plant growth, biomass production and plant stress indicators (i.e. chlorophyll content, leaf fluorescence, antioxidant in plant tissues) were investigated together with soil abundance, diversity and viability of soil microorganisms under the different growing conditions. The overall results showed the capability of the clone Monviso in the last two decades to bioremediate PCBs in roots. The PCB transformations were initially higher in the microbiologically active soil; subsequently in line with a high microbial growth of the sterilized soil, the amount of indicator congeners found were similar between the two treatments. The anoxic treatment differed in terms of congeners detected, microbial community structure and activity and plant physiology stress indicators. However, the Monviso clone showed an unexpected capacity to produce biomass under flooding treatment. Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field experiment of plant-assisted bioremediation.

TU245 Are PCB half-lives obtained in rhizoremediation experiments reliable? Pitfalls in experimental design and suggested guidelines for conducting the experiments
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Phytoremediation is gaining popularity as a sustainable solution to contaminated soil remediation. In particular, plant-assisted bioremediation exploits synergistic action between plant roots and natural microorganisms (bacteria and fungi) to remove, transform or stabilize toxic substances in soil, sediment or water. Such remediation technology can be effectively applied to contaminated areas. It is based on the use of suitable plant species, selected to stimulate the biodegradation activity of rhizosphere microorganisms (e.g. through the production of radical exudates or oxygen release). The plant-assisted bioremediation is an environmental recovery strategy for areas affected by widespread and multiple contamination, ecologically and economically viable. At the same time, this technology can provide wood biomass that can be efficiently treated to produce renewable energy. Among these treatments, biomass gasification is a very efficient process to produce clean energy in the form of a fuel gas (syngas). Among plant species poplar has good energy production potential, can grow in different environments and it is among the fastest growing trees. Furthermore, poplar demonstrated the capability to absorb organic contaminants (i.e. heavy metals) from the soil in which it is cultivated. For these reasons, the potential for synergizing bioremediation by using biomass collected from a plant assisted bioremediation area located in a contaminated soil in Southern Italy. The implementation of these technologies is line with the sustainability criteria of the Renewable Energy Directive (EC 2009) and with those of the “circular economy”, according to which by recovering energy from a material that would otherwise be a waste, taking care to separate any hazardous pollutants released during the process. An exhaustive Regulation, which establishes threshold limits of contaminants in the biomass and rules on how to manage it outside the remediation site, is necessary.

TU246 Effect of Organic and Inorganic Fertilizers on the Bioremediation of Used Motor Oil Polluted Soil
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Three treatments (poultry manure (PM), Nitrogen Phosphorus Potassium fertilizer (NPK), and a combination of both) were used for bioremediation of soil spiked with used motor oil to determine the potential of these treatments in enhancing biodegradation of used motor oil in soil. The degree of biodegradation of the oil was
studied for a period of 4 weeks under laboratory conditions. Hydrocarbon-utilizing bacteria counts were high in all the poultry manure-amended soil ranging between 9.0×10^9 and 3.0×10^{12} CFU/g compared to unamended control soil throughout the 4 weeks of study. Oil-contaminated soil amended with a combination of poultry manure and NPK fertilizer showed the highest reduction in total petroleum hydrocarbons with loss of 80% in the 4th week compared to other treatments. The results obtained demonstrated the potential of the treatments for oil bioremediation in the order: Poultry Manure and NPK > Poultry Manure > NPK.

TU247

Soil pollution and physico-chemical properties steer the bacterial community structure in the uneven highly polluted SIN Brescia-Caffaro site.

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Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity can be limited by spatial heterogeneity of microbial populations, contaminants and soil chemistry. Studies aimed at identifying the drivers of microbiome selection are therefore pivotal to develop in-situ bioremediation technologies. In this perspective, the Spatial Property Site SIN Brescia-Caffaro (Italy) offers a fascinating natural laboratory due to its extremely high, old, mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). Aim of our study was to evaluate the spatial correlations between environmental factors (pollutant fingerprints and soil physico-chemical properties) and the soil microbial community structure. More than 250 soil samples were collected in the SIN Brescia-Caffaro area along a tridimensional geostatistically conceived grid, and were analyzed to estimate the soil hydrolytic activity, the physico-chemical features and the concentration of metals and 79 PCB congeners. A cultivation-independent approach led to unravel the phylogenetic structure of the residing bacterial communities. By means of statistical analyses, we showed that significantly different bacterial communities were selected in the investigated areas within the SIN Brescia-Caffaro. Spatial distribution of bacterial populations within each site was significantly correlated with physico-chemical soil parameters and pollutant concentrations. Soil physico-chemical properties were also significantly correlated to the hydrolytic activity of the soil microbiome, a relevant indicator of soil quality and pollutant availability. The bacterial populations observed in the SIN Brescia-Caffaro area were significantly different from those observed in other contaminated sites in the Milan area. The study confirmed that the soil properties and the contaminant profile in the SIN Brescia-Caffaro shaped the structure of the residing bacterial communities, leading to hypothesize that it drove the selection of populations able to degrade the contaminants. The detection in the SIN Brescia-Caffaro soils of the hph gene, codifying for the biphenyl dioxygenase involved in the aerobic PCB degradation process, confirmed that they host an intrinsic bacterial potential for the remediation of contaminated areas. This study also highlighted the prospect of exploiting spatial patterns of bacterial diversity as proxies for monitoring polluted sites.

TU248

Laboratory-scale assessment of bioremediation of hydrocarbon-contaminated soil.

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Recalcitrant hydrocarbons often persist in contaminated environments. Biological remediation strategies (bioremediation) are a widely used approach to remove hydrocarbons. This study focused on bioremediation of hydrocarbons contaminated soil from an industrial active site using biopiles. The site is contaminated by light and heavy hydrocarbons, the latter ones representing the most recalcitrant fraction. Biopiles were designed by mixing amended soil with non-amended soil in the proportion of 1:1. The addition of recalcitrant hydrocarbons to the biopiles resulted in increased PAH concentrations. The efficiency of the bioremediation process was assessed by means of PAH concentrations in the soil and in the leachate. The results showed that the bioremediation process was effective in reducing PAH concentrations, from 10 to 97%. The bioremediation process was also effective in reducing the number of diesel degrading genera (C. Caffaro). Species richness and Shannon diversity were determined following the biodegradation process. The highest degradation rate was observed in CO bioreactors (first-order rate constant K=0.004 d^{-1}) while lower rates were observed in NA ones (K=0.004 d^{-1}). Bioremediation efficiency in the first 60 days of incubation. However, a residual TPH concentration of 900 ppm was reached in all bioreactors after 180 days starting from an initial concentration of 2660 ppm. The microbiological characterization highlighted a selection of the bacterial community according to the chemical results. In this respect, MNP results showed a significant increase in the number of oil-grown bacterial genera. These data will be confirmed by qPCR of the catalytic gene alkB encoding for an enzyme potentially involved in the biodegradation of hydrocarbons (on-going analysis).

TU249

Influence of Surfactants and Mycobacterium vanbaalenii PYR-1 Bioaugmentation on 14C-Pyrene Mineralization and Microbial Community Structure in PAH-Contaminated Soils

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants that have potential mutagenic, carcinogenic, and teratogenic properties. Bioremediation has been recognized as a versatile approach to remediate PAH-contaminated soils. However, the biodegradability of PAHs is limited by their bioavailability to microorganisms in the soil porewater fraction. To expedite biodegradation, surfactants at the critical micelle concentration (CMC) has been added to enhance the bioavailability of PAHs. The aim of this work was to evaluate the effect of a Brij-35 nonionic surfactant and rhamnolipid biocatalyst at three concentrations (0.1X, 1.0X, and 10X CMC) and the bioaugmentation of Mycobacterium vanbaalenii PYR-1 in PAH-contaminated soil using 14C-pyrene as a model compound. Additionally, the bacterial community structure after the 50 day incubation was analyzed using 16S rRNA gene high-throughput sequencing and PAH-degrading genes were predicted using phylogenetic investigation of communities by reconstruction of unobserved states (PICRUSt). The addition of Brij-35 surfactant at all three concentrations resulted in increased PAH mineralization after 50 days incubation by indigenous microbe populations in the sandy loam and clay soil compared to the unamended and rhamnolipid-amended soil treatments. The bioaugmentation of M. vanbaalenii PYR-1 had an immediate impact on PAH mineralization in both soils, resulting in a 70-80% decrease in PAH concentrations up to 5,000 ppb in the swallow aquifer. In 2016, t...
VOCs potentially migrating from beneath the former facility. A total of 4900 kg of ELS concentrate was emulsified and injected under pressure through 51 fixed wells in the swallow contaminated aquifer. Subsequent field monitoring showed PCE and TCE below detection limits at all wells after 6 months. A 99.8% reduction of PCE and TCE was observed in the source and plume areas along with the reduction of the recognized catabolites, such as DCE or VC. Moreover, complete reductive dechlorination of 1,2-dichloroethane has also been observed in all the monitoring wells.

TU251
Cheese whey effects on microbial communities in contaminated groundwater of an urban area

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Interestingly, in combination with nZVI molasses enhanced growth of bacteria (apsA). CMC as the substrate for dehalorespiring bacteria was not prevailed in higher concentrations. Moreover, high concentrations trigger dehalogenation of the CE contaminants. Specific markers are still being monitored in the treated groundwaters and will be discussed together with physico-chemical results.

TU252
The Influence of Nanoscale Zero-valent Iron (nZVI) in Combination with Various Organic Compounds (Modifiers) on Dehalorespiring Microflora

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Groundwater polluted with electroactive contaminants contains chlorinated ethenes (CE) are the second most ubiquitous contaminants worldwide. Herein we describe an urban locality Novy Bydzov (Czech Republic) where groundwater pollution was identified in private wells in 2007. The source of CE was machinery, metal cutting, and chemical industry, now out of order. The improper handling of hazardous compounds (e.g. chlorinated hydrocarbons, mineral oils etc.) caused uncontrolled contamination of Quaternary aquifer which is about 4-5 meters thick, composed of sandy gravel and delimited by impermeable 400 meters thick Mesozoic strata. Application of different carbon sources (lactate, glucose, cheese whey and polyhydroxybutyrate) on the CE-contaminated groundwater was previously tested in the bench-scale studies and based on these experiments, cheese whey was chosen for the in situ application. The effect of three consecutive cheese whey applications (first was in October 2017) on indigenous microbes was described using qPCR Due to the techniques after sampling time the DNA extraction was performed using a FastDNA Spin Kit for Soil according to manufactures’ protocol. Extracted DNA was quantified using Qubit 2.0 fluorometer. Isolated samples were tested using qPCR method. An universal marker, 16S rDNA gene (total bacteria marker) was used as a control. Other monitored specific markers were focused on presence of Dehalococcoides, Dehalobacter, Sulfitobacterium and vinyl chloride (VC) reductases vcrA and bvcA. In addition denitrifying bacteria were monitored by nirK marker and sulfate reducing bacteria by dsrA2 marker. All data are counted in relative values. Higher bacterial abundance was detected based on all tested markers after the first cheese whey application. This application will be repeated two more times. Generally, application was successful and bacterial biomass and specific markers for organohalide respiration increased and prevailed in higher concentrations. Moreover, high concentrations trigger dehalogenation of the CE contaminants. Specific markers are still being monitored in the treated groundwaters and will be discussed together with physico-chemical results.

TU253
Mechanistic insight into microbial reductive dehalogenation

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Microbiologically mediated reductive dehalogenation provides a promising approach to remediate and detoxify halogenated aromatics. Despite extensive respective studies, the mechanistic understanding of the underlying chemical reactions is still limited. Interestingly, Dehalococcoides mccartyi strain CD1B1 and Dehalobacter strain 14DBC1 share a common substrate spectrum but yield different dehalogenation patterns, suggesting different sites of primary attack (chemically bound halogen vs. H) by the nucleophile cob(II)alamin (vitamin B12). The latter was unravelled through quantum chemical analyses of respective electron structure characteristics. Building on these recent results, a perturbational analysis of the molecular initiating event triggering the reductive dehalogenation. Application to 93 aryl halides covering chlorinated benzenes, phenols, anilines, biphenyls, dibenzo-p-dioxins, and brominated benzenes reveals that the lowest symmetry-compatible e* orbital located at the carbon-halon bond mediates the dehalogenation step, and enables discriminating CD1B1-active from non-active substrates. In this regard, we demonstrate the feasibility and effectiveness of various substrates including applications of the MO approach for predicting dehalogenation pathways and regioselectivity. Overall, our approach supports the view that the reductive aromatic dehalogenation proceeds through an inner-sphere electron transfer.

TU254
Bacterial biosorption of PFOS from contaminated waters

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Per- and polyfluorinated alkyl substances (PFAS) have been extensively used for commercial and industrial products since the mid-1960s. Although they have been classified as bioaccumulative hazardous organic compounds (Stockholm convention 2009). Perfluorooctane sulfonate (PFOS) is highlighted as the most abundant PFAS reported to contaminate the environment, animals and humans. The most frequently applied method for PFOS remediation of water is by passing it through activated granular carbon filters. Currently, there are increasing efforts for new strategies for PFOS remediation due to their bioremediation with dead bacteria as a promising alternative approach. We propose that microbial biosorption of PFOS can be applied as a novel, less costly technique for PFOS environmental elimination.

TU255
Hexavalent chromium reduction in a biocathodic microbial electrolysis cell

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Groundwater is the environmental matrix most frequently affected by anthropogenic hexavalent chromium contamination. Due to its cancerogenicity, Cr(VI) has to be removed, hopefully using environmental-friendly and economically sustainable remediation technologies. To overcome the limits of the currently applied bioremediation technologies, an alternative strategy is the use of BioElectrochemical Systems (BESs) to stimulate bioreduction of Cr(VI). BESs include a set of technologies based on biocathodic microelectrode reactors where an electrode (anode) can function as the final electron acceptor for the oxidation of organic compounds; then electrons flow through the circuit and reach the cathode that acts as the electron donor for the bioreduction of oxidized species. In the present study, we have assessed if Cr(VI) can act as an efficient terminal electron acceptor for an anaerobic biocathode in a Microbial Electrolysis Cell (MEC). The cathode was first inserted into the cathodic compartment of a dual-chamber Microbial Fuel Cell, and inoculated with autotrophic cultuige originating from anaerobic digestate sludge. After 30 days of acclimation, the electrode was transferred into the cathodic chamber to work at -300 mV (vs. SHE) as the biocathode in a Cr(VI)-reducing MEC. An
abiotic control and an open circuit (OC) control were also operated in parallel. Hexavalent chromium dissolved concentration was analyzed at the initial, during the experiment and final time by spectrophotometric method, while the dissolved total chromium was analyzed by ICP-MS. During the whole test, the current intensity was monitored. At the end of the experiment, the microbial characterization of the communities enriched on the biocathode and in the cathodic enrichment preculture had better performance than the FeC one (shorter start up time, lower anode potential, higher current density and power density). The main source of variability resulted to be the kind of enrichment, both in the preculture and in the MFCs. Proteobacteria, Bacteroidetes e Firmutes resulted as the main Phyla in our samples. Geoabaetaceae spp. and Pseudomonas spp. decreased more during the FeC enrichment and their DNA concentration was higher in the Gen-MFCs and FeC-MFCs, respectively. Microbial population enriched with FeC showed a lower Shannon diversity index, both in the preculture and in the MFCs. Proteobacteria, Bacteroidetes e Firmutes resulted as the main Phyla in our samples. Geoabaetaceae spp. and Pseudomonas spp. decreased more during the FeC enrichment and their DNA concentration was higher in the Gen-MFCs and FeC-MFCs, respectively. Microbial population enriched with FeC showed a lower Shannon diversity index, both in the preculture and in the MFCs. Proto...
conditions to simulate both natural attenuation and biostimulated degradation processes. Enrichment factors for $^{13}C$ were determined by Compound Specific Isotope Analysis (CSIA). High-throughput sequencing (Illumina) and Ion Torrent analysis and quantitative PCR were performed to gain insights into the structure of the microbial community and to identify functional biomarkers. The investigation of the potential anaerobic degradation pathways is not shown because the obtained data and their interpretation during anaerobic degradation. MBW was completely depleted upon addition of nutrients and CSIA results confirmed negligible C isotope fractionation under oxidative conditions. The catalytic toluene gene, encoding for toluene dioxygenase, and Pseudomonas were identified as molecular and taxonomic markers, respectively. Finally, analyses of the identified molecular and taxonomic markers for the aerobic degradation of MBW could also be performed in another area contaminated by MBW, and nearby the first site, to establish whether an aerobic approach for site reclamation from MBW could be successful in the extended area.

**TU260**

**Isotopic and Molecular Biology fingerprinting of a complex contaminated industrial area**

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Biotransformation and Biodegradation of a MVCP contaminated areas with multiple pollutant sources and different environmental conditions represent a big challenge to site owners. Therefore, a detailed chemical, isotopic and microbial site characterization (fingerprinting) is crucial to evaluate, at first, the intrinsic remediation of the contaminated area (natural attenuation) and, then the potential of enhancing specific biodegradation processes (biostimulation). This study aimed at gathering chemical, isotopic and molecular biological data from a contaminated industrial area to quantify the complex mixtures of contaminants, to provide information about the sources of contamination and to assess the potential of degrading and, thus to enhance the on-going biodegradation processes. Contaminated groundwater was collected from 19 piezometers in a restricted area of the site. Chemical analyses of chlorinated ethenes, 1,1,2-trichloroethane (1,1,2-TCA), 1,2-dichloroethane (1,2-DCA), benzene, toluene, xylene isomers, ethylbenzene and chlorinated benzenes were performed following the standard protocols. Compound-Specific Carbon Isotope Analysis (C-CSIA) were carried out to define the isotopic signatures of 1,1,2-TCA, 1,2-DCA and chlorinated solvents (PCE, TCE, 1,2-cis-DCE, VC). The structure of the microbial community was determined by Illumina High Throughput Sequencing, whereas its functional profile was assessed by quantitative PCR of key genes encoding for enzymes involved in specific metabolisms. Trichloroethylene and 1,2-dichloroethane (1,2-DCA) were found in most of the water samples at high concentration as well as 1,2-cis-DCE. Illumina sequencing data showed a large bacterial diversity probably due to contamination heterogeneity. However, species belonging to the genera *Sphingomonas* and *Rhodocyclales* were prevalent. These genera are known as potential degraders and, thus to enhance the on-going biodegradation processes. The microbial community was characterized by high diversity and richness, showing metabolic versatility. They are able to thrive even in extreme environments. Very few species showed a high potential impact on a planetary scale. They are ubiquitous and show remarkable metabolic versatility. They play a crucial role in biogeochemical cycles function. They determinant for the water, air and soil quality, the productive and non-productive services offered by functional microbial biodiversity to improve the human wellness and sustainability. Currently, a much interest is addressed towards biotechnological techniques that supply clean and affordable renewable energy sources exploiting the activities of microbial communities. This is the case of the anaerobic digestion (AD) process, through which, in the absence of oxygen, the complex organic matter is transformed into gaseous products, such as CH$_4$, H$_2$ and CO$_2$. Although the engineering and technological aspects of the AD have been thoroughly studied, the microbial community is still managed as a ‘black box’, since most of the AD plants lack microbiological planning and monitoring. On the other hand, interactions between the microbial components have an essential role on the biodegradation process. Disruptions in the AD process are often related to a poor understanding of the ecology of the microorganisms responsible for the associated biochemical reactions. In this work, insights about microbial community dynamics, investigated with innovative molecular techniques, are presented in order to improve the understanding of the links between natural and biotechnological ecosystems, and, by applying microbial ecology principles, improve the environmental engineering practices.
Formation potential of trifluoroacetate and its estimation by means of the TOP assay
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Trifluoroacetate is the perfluorinated carboxylic acid with the shortest-possible chain length and thus a small, persistent molecule. Due to its high acidity (pKₐ < 0.23) it occurs in its anionic form (trifluoroacetate, TFA) in the aquatic environment and is considered as highly mobile. Photochemical conversion of volatile refrigerants (e.g. 1,1,1,2-tetrafluoroethane) is the most frequently discussed anthropogenic source of TFA. However, its formation in the environment has also been shown for other substances containing trifluoromethyl moieties. Hence, a large number of active substances in modern crop protection agents, pharmaceuticals or industrial chemicals have to be regarded as potential TFA precursors. In the present study, the TFA formation potential of environmentally relevant substances was determined using the so-called total oxidizable precursor assay (TOP assay). In order to analyze the resulting concentrations of TFA, a method for quantitative extraction of the analyte from the highly alkaline and saline digestion solutions was developed. The subsequent measurement was performed using high performance liquid chromatography coupled to tandem mass spectrometric detection (IC-MS/MS).

Persistence & Biodegradation Assessment (P)
TU267
Implication of microbial adaptation for the persistence of emerging pollutants
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Regulatory determination of the persistence of organic chemicals is mostly done using OECD ready biodegradability tests (RBSTs). RBTs, however, suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. The origin and history of the inocula is one of the major causes of that variability. Nowadays, it is evident that results of RBTs change over time as microbial populations apparently adapt within years to metabolise previously persistent chemicals. Several studies also show an improvement of the biodegradation rates even after a short period of pre-exposure to the tested chemical. As such, there is a need to assess the influence of this process on RBTs. We, therefore, used chemostat systems to expose activated sludge microbial communities to 4-chloroaniline, 4-chloro-2-nitroaniline, and 4-chloro-2,6-dinitroaniline. Two of these chemicals are considered as emerging contaminants and are persistent according to RBTs. The biodegradation capacity of the activated sludge and of the exposed inocula was assessed in batch culture using the OECD 310 guideline for testing of chemicals. Different phases of biodegradation were measured following CO₂-production (OECD 310) and the compound and product concentration by LC-MS/MS. Community changes in the chemostats were determined by 16s RNA sequencing. The results of these experiments show enhanced biodegradation capacity for N-methylparipenazine after pre-exposure to this molecule. Moreover, microbial communities exposed to metformin were able to degrade this molecule and its known persistent transformation product, guanylurea, which is considered as persistent in fresh water. These preliminary results show that microbial communities can adapt to degrade a molecule that was initially persistent. These results are a first step to understand adaptation mechanisms and their implication for the persistency of organic compounds of emerging concern. This project aims at correlating microbial adaptation and biodegradation performance in time. The ultimate aim is to design more robust and realistic RBTs adapted inocula.

TU268
Prioritization of organic compounds based on their persistence in dissolved phase
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When considering the large number of chemicals potentially present in the environment, the scientific community seeks to establish a pertinent list of priority compounds. Assessing the persistence of chemicals such as pharmaceuticals or polar pesticides represent a need in order to realize a better prioritization of compounds of concern. Persistence in dissolved phase is widely dependent on intrinsic properties of compounds but also on environmental conditions such as temperature, salinity, or presence of microorganisms. Estuaries are characterized by gradient and high variability of salinity and suspended solids (SS). The environmental risk assessment may need to be adapted to dynamic conditions such as those prevailing in transitional areas. This study focuses on the persistence of polar pesticides and pharmaceuticals into turbidity maximum zone of the macrotidal Seine estuary. Laboratory batch experiments simulating mixing conditions of the discharge of wastewater into estuarine water were performed. The influence of SS concentration, salinity and abiotic control was assessed on a selection of 60 polar pesticides and 51 pharmaceuticals. In order to compare relative compound persistence in dissolved phase, a persistence index based on the half-lives of the compounds was calculated. Briefly, marks depend on half-life values of each condition, and the average mark gives the persistence index. Risk quotient is calculated with measured environmental concentrations of each compound in the Seine estuary. Of the 111 monitored compounds, 33 were quantified at the initial time. Only 3 exhibited a persistent behavior (e.g. atrazine) while biotic degradation was shown to be the main attenuation process for 15 molecules (e.g. diuron). Degradation was enhanced by increasing concentrations of suspended solids. Because half-lives of compounds presented important variations between all experimental conditions, valuable prioritization was complex to achieve in such conditions and consequently in transitional zones. A persistence
index and measured concentration in the Seine estuary were used together and allowed a categorization of compounds into 4 levels of environmental concern. Moreover, non-targeted analysis highlighted the formation of 794 compounds during 21 days of incubation, in high concentration level of SS condition. In order to improve risk assessment, formation of transformation products should have to be considered and included in prioritization schemes.

TU269

OECD 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers
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Persistent pharmaceuticals in aquatic ecosystems are of particular societal concern and the OECD 308 guideline is often used to obtain the biodegradation half-lives required for risk assessment. The environmental relevance of OECD 308 has been criticized in recent years, mentioning the difficulty to interpret multiphasic processes (biotic and abiotic) and the lack of compartment-specific half-lives for water or sediment as an outcome. In particular, biodegradation processes in the sediment can vary according to the microbial communities, which may be impacted by the settings chosen for the test (i.e. sediment-water ratio, aerobic-anaerobic conditions and initial concentration levels). In this study, we have investigated the differences in biodegradation of a mixture of 9 pharmaceuticals (acetaminophen, caffeine, carbamazepine, diclofenac, flucloxacil, metformin, oxazepam, tramadol, and venlafaxine) using water and sediment collected from rivers Fyris and Grindadalselva, before and after the discharge of a wastewater treatment plant (WWTP). Bottle incubations were set following the OECD 308 guideline, spiked with pharmaceuticals and incubated for 60 days at 16°C in the dark with daily aeration. Water samples were taken at 10 time points and analyzed in UHPLC-MS/MS. The microbial community composition in the sediment was analyzed with Illumina sequencing of bacterial 16S rRNA to provide more insight into the biodegradation potential in the different treatments. The dissipation half-lives obtained for diclofenac, oxazepam, tramadol, and venlafaxine are significantly different (p<0.001) between rivers and between locations. Additionally, the half-lives of non-sterile treatments are significantly shorter than sterile (<0.01) for all compounds except carbamazepine, indicating that dissipation reflects a combination of biodegradation and sorption mechanisms. Furthermore, compound concentrations remained constant in river water treatments, with only caffeine and acetaminophen showing signs of degradation. Dissipation of pharmaceuticals in the sediment could not be entirely excluded. In order to have a more relevant half-life estimate, sorption cannot be completely excluded, the experiment results indicate that the biotic processes could be divergent between rivers, but also between sediments taken up- and downstream the WWTP. An analysis of the microbial diversity in sediment and water of each river will complement the differences in dissipation rates observed for the treatments.

TU270

Compartment-Specific Screening Tools - Development and Application to Assess Potential Persistence of Organic Compounds in Water, Sediment and Soil
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The persistence assessment under REACH ideally relies on compartment-specific degradation half-lives that are generally derived from aerobic laboratory simulation studies for surface, aquatic sediments or soil. Although these data are given top priority, they are not available for most of the compounds since simulation tests are time-consuming and expensive, and they are required only for compounds with a production volume or more tons per year. Thus, screening information (e.g. results from ready biodegradability tests (RBTs) or quantitative structure-activity relationship (QSAR) models) are used in the absence of simulation test data to decide whether a substance is considered as “not persistent” or “potentially persistent” according to screening criteria. However, RBTs only provide information on the water compartment. QSAR tools are mainly developed based on qualitative experimental biodegradation data related to water-only test systems. Therefore, half-lives for soil and sediment are calculated by multiplying the half-life in water by constant factors. However, this extrapolation is questionable due to different conditions in the compartments, which might affect biodegradation in connection with the physico-chemical properties of the compounds. Consequently, there is a lack of experimental quantitative biodegradation data for soil and sediment at the screening test level. In the present work compartment-specific screening tools for water-sediment (Water-Sediment Screening Tool, WST) and soil (Soil Screening Tool, SST) were developed based on the existing MITI test system (OECD TG 301C). The test systems MITI, WST and SST were applied to determine biodegradation data for a set of fifteen test compounds. The results demonstrate that the WST and the SST are suitable to determine sound and reliable biodegradation data including biodegradation kinetics for compounds on the screening test level. Furthermore, the results were used within the scope of a Compartment-Specific Persistence Screening (CSPS). The results of the CSPS were in good agreement with the REACH standard persistence screening, resulting in slightly more conservative but reasonable results. Thus, the data can be applied to identify potentially persistent compounds in the regulatory context. Beyond that, the results can be used as input parameters for multimedia fate models to assess the environmental fate of the compound, e.g. overall persistence (P₅₀).

TU271

Persistency assessment of pesticides in Denmark
A. Gimsing, The Danish Environmental Protection Agency / Pesticides and Gentecno; A. Aagaard, S. Marcher, The Danish Environmental Protection Agency / Pesticides and Biocides; V. M. Krier, The Danish Environmental Protection Agency

Persistent active substances can affect the environment over long periods of time, as such substances can be distributed and accumulated within and outside the areas where they are used. Persistent substances constitute a long-term and difficult-to-quantify risk of spreading in the environment and affect organisms. Persistent substances can also cause effects on and lead to residues in subsequent crops. This also applies to the metabolites of an active substance. Therefore active substances with a DT50 above 180 days cannot be approved in Denmark. The persistency evaluation is based on an assessment of available reliable half-lives from both laboratory and field studies. All half-lives should be normalised to 20°C and pH2. Assessment of persistency should not be based on average or percentile values of the data. Instead data are assessed by considering the soil types used and focusing on soil types representative for Danish conditions. If in general these soils have a DT50 above 180 days, products with such active substances cannot be authorized for outdoor uses in Denmark. If only some of the soil DT50 values are above 180 days, an ad hoc assessment is performed to decide if these findings constitute the major part of data and if it is likely that DT50 for Danish soils is above 180 days under field conditions relevant to the intended use. The persistency evaluation should be performed for both the active substance and metabolites. However, metabolites which fulfill certain criteria are considered to be of no concern regarding persistency.

TU272

Influence of Winter Conditions on Fungicide Persistence in North American Golf Course Turfgrass
P. Koch, University of Wisconsin - Madison / Molecular and Environmental Toxicology Center

Fungicides are routinely applied to golf course turfgrass prior to winter in temperate climates around the world to protect the plants against psychrophilic plant pathogenic fungi. The persistence of these fungicides under cold conditions is important as the environmental conditions present during winter is poorly understood despite important implications for human and environmental health as well as disease control on the turf. A 3-year field study was initiated at the University of Wisconsin - Madison (Wisconsin, USA) in 2015 to determine which environmental conditions most influenced the persistence of the fungicides propiconazole and chlorothalonil. For this purpose, a targeted analysis highlighted the formation of transformation products which fulfill certain criteria and a bioassay was conducted in a controlled environment chamber using the psychrophilic plant pathogenic fungus Microdochium nivale to determine the date when disease protection was lost. Fungicides were applied once on 20 Nov 2015 and again on 5 Dec 2015 on a 10-cm diameter turfgrass cores were collected biweekly from the experimental area. Both fungicides were applied during the growing season in December with frequent rainfall events, and the concentrations of both fungicides in the turfgrass leaf tissue fell dramatically within the first 28 days after application. In addition, a corresponding increase in M. nivale -disease symptoms in the controlled environment chamber was observed as fungicide concentration decreased. These results suggest that fungicides do not persist in winter conditions following rainfall events, though it remains unclear whether they persist for prolonged periods of time on frozen turf and under prolonged snow cover.

TU273

Biodegradability of novel graft copolymer with levan and polystyrene
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The significant increase in plastics productions caused waste management and recycling problems which is particularly relevant for polystyrene plastic as the most dominant packaging material. Therefore, investigations of new biodegradable polymers are increasing. Graft copolymerization is important technique for physical and chemical modification of polymers. The microbial levan is biocompatible, biodegradable, renewable and eco-friendly fructose based polymer. It can be produced from surose by wide range of microorganisms using levansucrase enzyme. In the present study graft copolymer with microbial levan and polystyrene was synthetized, characterized and its biodegradable potential was investigated.
Levan was isolated after fermentation of Bacillus licheniformis strain. Syntheses of copolymer were performed by the free radical reaction using potassium persulfate as initiator. Verification of the synthesis was recorded by 13C NMR Bruker AVANCE III 500 spectrometer. Biodegradation potential in aerobic conditions of obtained copolymer was investigated using Micro-Oxymax respirometer (Columbus Instruments, Ohio). O2 consumption of samples mixed with soil was measured in period of 28 days. The 13C NMR spectrum of copolymer showed the presence of both copolymer components and unreacted monomers O2: sample in copolymer sample (705.0 L) compared to control (350.9 L) and polystyrene (499.5 L) after 673 h. The formation of levan and polystyrene graft copolymer was confirmed by 13C NMR analysis. Results after 28 days in aerobic biodegradation in soil shows that obtained novel copolymer has biodegradation potential, however additional tests for biodegradation are needed.

TU274 Aerobic degradation of styrenated phenol in soil: influence of the temperature and of the characteristics of the soils
M. Emiri, SOLVAY / HSE - PRA PSI; P. Chagnon, SOLVAY / Research and Innovation

The persistence of chemicals is assessed through their kinetics of degradation in the environment. Several simulation tests are available to evaluate the half-life of the chemicals in different environmental compartments. The half-life is then compared to the Annex XIII criteria of REACH to decide if the substance is be considered as Persistent (P) or very Persistent (vP). Nevertheless, the interpretation of these tests is complex. Degradation [14C]2,4- and [14C]2,6-TDA was studied and depicted, despite a standardization of the methods. In the present project, the rate and route of transformation of a styrenated phenol compound was investigated in four different soils and at two temperatures: 12°C and 20°C under aerobic conditions. Statistical analysis is performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

TU275 Comparison of kinetics and products of degradation determined for the toluenediamine substances in the OECD-standardized ready biodegradability and sediment simulation tests
C.R. Boezi, BASF SE / FEP/PA; C. Gaertner, Fraunhofer Institute for Molecular Biology and Applied Ecology IMAE; H. Schwarz, BASF SE / RB/TC; R.J. West, International Isocyanates Institute, Inc. / Toxicology and Environmental Research Consulting

The OECD ready biodegradability tests (RBT) are designed to approximate the rate/extent to which substances are degraded in the environment, such as is more precisely measured in the OECD simulation tests. This work compares results obtained from both tests type for degradation of the toluenediamine (TDA) substances. Degradation [14C]2,4- and [14C]2,6-TDA was studied and depicted, despite a standardization of the methods in the OECD Guideline Nos. 301B and 308, wherein their disappearance, formation of non-extractable residues in the sediments. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

TU276 Evidence for Anaerobic Microbiodegradation of PCBs and PBDEs in Sediment cores from an e-Waste Site, South China
B. Mai, Guangzhou Institute of Geochemistry; C. Huang, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences; Y. Zeng, Guangzhou Institute of Geochemistry

Biodegradation of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) is an important transformation and detoxification route in the environment. To better understand the in-situ microbial degradation of PCB and PBDE in anaerobic sediment, three sediment cores from an e-waste dismantling site, South China, were sampled (named #1, #2, and #3, respectively). Permutation factorization model (PMF), compound specific isotope analysis (CSIA), and microorganism analysis were used to trace the in-situ biodegradation of these pollutants. High levels of PCB (44-67800ng/g, dw) and PBDE (62-79200ng/g, dw) were found in all the samples and the concentrations were general increased from bottom to the top layers. PMF analysis indicated that the technical mixtures were the dominant PCB and PBDE input and dehalogenation takes place in the sediment cores, especially for PBDEs. This conclusion was supported by the microorganism analysis, substantial Delahococci were found in the sediment cores. The range of the relative abundance of Delahococci for three sediment cores (#1, #2, #3) were 1.0-9.0%, 1.4-7.5%, and 0.2-2.5%, respectively, which were significantly correlated with the ratios of factor 2 (biodegradation source) / PBDEs (with the p-values of 0.02, 0.05, and 0.01, respectively) As for CSIA analysis, only the stable carbon ratios (δ13C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20cm of the sediment cores were obtained. An increase in the δ13C values for BDE 28 and a slightly decrease in the δ13C values for BDE 85 were found with the increase of the depth sediment cores, indicating a potential biotransformation of these compounds in the cores. No significant differences in the δ13C values of BDE 47 and BDE 99 were observed in the sediment cores, possibly due to the complicated fate of these compounds, such as BDE47 and BDE99 being both reactants and products during the debromination processes.

TU277 Transformation and degradation mechanisms of flame retardant triphenyl phosphate in aquatic environment
Y. Choi, Gwangju Institute of Science and Technology; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

Organophosphate flame retardants (OPFRs) in aquatic environment are concerned because they are latest alternative chemicals of brominated flame retardants. Among OPFRs, triphenyl phosphate (TPHP) shows high consumption volumes, as well as high concentration in water. TPHP caused toxic effects especially in aquatic organisms but research of biotransformation products is insufficient. Kinetic studies of TPHP and transformation products are important to understand the effects on environmental organisms. To identify the biotransformation products of TPHP, daphnia magna (Tetrahymena) was used due to short biotransformation time in aquatic environment. TPHP was exposed to individual daphnia magna and each samples were separated by biota and remaining medium. Daphnia magna were homogenized and remaining medium were extracted with solid phase extraction. Samples were analyzed using liquid chromatography-tandem mass spectrometry (LC/ESI-MS/MS) for quantitation and ultra-high-performance liquid chromatography-electrospray high-resolution tandem mass spectrometry (UHPLC-HRMS/MS) for qualification. Two major biotransformation products were detected in the study based on phase I & II biotransformation mechanisms. Diphenyl phosphate (DPHP), product of phase I reaction, was identified for biotransformation products both biota and medium. Among phase II reaction, sulfonyl triphenyl phosphate was verified; intermediate metabolites were not significantly detected due to brief retention times. Parent compound (TPHP) and hydrolysis products (DPHP) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DPHP; as TPHP showed decreased, degradation product (DPHP) ratios increased. In conclusion, hydrolysis and sulfation were major mechanisms for biotransformation products of TPHP in environment. As a result, the risk to aqueous organisms must be estimated in order to develop regulations for organophosphate flame retardants in aquatic system.

TU278 Photolytic and biological degradation of silicon organic compounds
E. Theple, Leuphana University Lueneburg; O. Otsone, Leuphana University of Lueneburg / Institute for Sustainable and Environmental Chemistry; N. Mitzel, University Bielefeld / Inorganic and Structural Chemistry; K. Kuemmener, Leuphana University Lueneburg / Institute of Sustainable and Environmental Chemistry

This study provides new data on the degradability and persistence of a selected group of silicon organic compounds, which are latest alternative chemicals due to the complicated fate of these compounds, which are frequently produced in high amounts. They are widely used in industry, personal care products and agriculture. In general, silicones occur ubiquitously in the environment in different concentrations (e.g. in water from ng to mg per L). Since these polysiloxanes are only cleavable by hydrolysis and sulfation were major mechanisms for biotransformation products of TPHP in environment. As a result, the risk to aqueous organisms must be estimated in order to develop regulations for organophosphate flame retardants in aquatic system.

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photolytic and biological degradation of these substances in aqueous solutions. Each compound was irradiated with artificial sunlight (solar lamp, 300–800 nm, SUN-test CPS). During the irradiation time of 8 hours, samples were taken every two hours and analysed directly with HPLC-U/Vis. An adapted closed bottle test (OECD 301 D) was used to investigate ready biodegradability. The degradation rate was determined by measuring the depletion of diluted oxygen during a period of 28 days under aerobic conditions and is related to the amount of sunlight degradation in each experiment at a constant degree. After 6 hours, 99% of the substance p-Me,NC6H4SiMe3 was primarily eliminated. During the test, generation of more polar transformation products was observed. The other substances were eliminated between 15 and 65% with treatment of sunlight during a time period of 8 hours. No ready biodegradability could be observed for these five substances. The results from the biodegradation test were used to calculate a degradation rate for each compound. The OECD 309 simulation test is important tests for providing kinetic biodegradation data in surface waters for use in biodegradation assessment and risk assessment. The OECD 309 guideline (“Aerobic Mineralization in Surface Water”) is one of the most important guidelines to assess biodegradation potential with with bentonite/diesel (BED) model and lowest biodegradation potential with organozeolite/mazut (OZM) model, with cells consumption of 80913,53 μmol O2/100 ml within 115 hours, respectively. The production of CO2 by cells in BED model was more than twofold higher than by OZM model. As well, BED model obtained highest TPH decomposition at the end of experiments. This results indicate that bioremediation process can be successfully used on adsorbed pollutants, where added value is recycling of sorbent material, but further investigation are required to determine the best sorbent pool for each of potential pollutants from environment. Acknowledgements This work was supported by Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No: III 43004.

TU280 Applying high-resolution mass spectrometry to evaluate chemical persistence in un-spiked natural waters
Z. Li, Stockholm University / ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES) Microbial degradation is an important mechanism for removal of organic pollutants in natural systems. As a consequence, microbial biodegradability is a fundamental determinant of the environmental fate of the compound. The OECD 309 guideline (“Aerobic Mineralization in Surface Water”) is one of the most important tests for providing kinetic biodegradation data in surface waters for use in persistence assessment and risk assessment. The OECD 309 simulation test measures biodegradation in aerobic natural waters that have been spiked with test chemicals and incubated in the laboratory. However, these experimental conditions do not accurately simulate natural aquatic environments, where a variety of microbial organisms are exposed to chemicals with much lower concentrations. As a result, legitimate questions have been raised about the ability of such biodegradability tests to predict persistence of compounds in natural systems. This study was designed to test the hypothesis that biodegradation is significantly different in a spiked system than in a natural system, OECD 309 experiments were carried out with and without spiking. Water from Lake Norra Bergudjasen in southern Sweden was used, a recipient for wastewater treatment plant effluent with a freshwater dilution factor of ~4. A mixture of 16 test compounds comprising a range of biodegradability was used for the spiked systems. Four sets of experimental conditions were used (all in duplicate), i.e., spiked lake water, un-spiked lake water, spiked artificial lake water (inflowing lake water mixed with the effluent (80:20, v/v) from the wastewater treatment plant which discharges into the lake), and un-spiked artificial lake water. Incubation conditions followed the standard OECD 309 protocol, lasting for a period of 60 days at 20 °C in the dark. Triplicated water samples were taken at 1 time point per week. After addition of mixture of internal standards, the aliquots were filtered and analyzed with UHPLC-Orbitrap-MS/MS using direct injection. Data was processed using both the target approach and the non-target approach, where the implementation of liquid chromatography coupled to high-resolution mass spectrometry allows for screening of organic contaminants in aquatic systems. The biodegradation kinetics (half-lives) of the detected compounds in the spiked and un-spiked waters will be compared and contrasted to evaluate the hypothesis.

TU281 Development of a multi-sensors device to assess the biodegradability of chemicals
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This work was supported by the European Commission within the framework of the LIFE programme (LIFE13 ENV/FR/000065) and the LIFE programme (LIFE13 ENV/FR/000349). Buoyant Algae Research Centre (BARC), University of Nantes / GEPEA CNRS UMR CBAC Laboratory; M. Cregut, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; L. Catherinet, E. Calzolari, V. Pichot, TRONICO; C. Sweetlove, IOREAL SA / Research and Innovation; J. Chenèble, L'Oreal Research / Research and Innovation; J. Lihardson, L'Oreal Research & Innovation / Life Sciences Direction; T. Gerald, University of Nantes / Microbiology

Most of the methods used to evaluate biodegradation have been developed for almost 50 years. According to the fact that annually, hundreds of new chemicals require a biodegradability assessment; the development of new methodological solutions needs to be investigated. Indeed, few measurement systems, enabling an automated assessment for substances of known composition but not for complex or oxygen consumption measurements, which present certain limitations to assess complex or volatile chemicals. To increase the reliability of the assessment, notably for volatile and complex chemicals, our objective was to develop a multiparametric platform disposing of its own measuring methodology. A research project was therefore conducted to develop this methodology while integrating automation of measurements to tackle another major challenge in biodegradation assessment. To reach this technological bottleneck, a validation of different technologies of sensors has been performed to assess their reliability and accuracy in operating conditions. This first step is crucial prior to establish a carbon balance analysis, using several
modeling steps involving the use of different parameters such as O₂, CO₂, pH, T°C, Pressure and Biomass. These technological investigations will be used to create an unique automated device enabling the evaluation of biodegradation of a chemical whatever its physicochemical characteristics.

TI/263 Investigations on key parameters of an innovative biodegradation test based on cell proliferation

S. Rey, Firmenich / Biotechnology; B. Özel Duygan, University of Lausanne / Fundamental microbiology; S. Leocata, L. Baroux, P. Merle, Firmenich; J. van der Meer, University of Lausanne / Department of Fundamental Microbiology; M. Seyfried, Firmenich

Screening and OECD screening tests for biodegradation are useful tools for determining the potential of chemicals to undergo decomposition and mineralization in the environment. Most of these are carried out at high test compound concentration and are based on simple readouts such as CO₂ formation or oxygen consumption, and usually neglect biomass formation. Our research attempts to fill a gap in the knowledge on bacterial physiology in tests conducted at more environmentally relevant concentrations of industrial chemicals compared to existing OECD 301 series tests. Recently the feasibility of performing cell counting by flow cytometry was demonstrated for mixed cultures from WWTP sludge and lake water. The present poster reports on key parameters of this new biodegradation test method, notably effects of initial cell and test compound concentration and test duration on the test outcome, as well as on yield determination and on data analysis of flow cytometric cell counting. As test compounds, selected reference chemicals were chosen from the ECETOC MCCI/007 report list suggested for method development for readily and non-biodegradable compounds. Aside cell counting, several test compounds were analyzed in parallel for CO₂ and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

TI/284 Challenges and Solutions of Ready Biodegradation Study with Difficult Substances

T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tamaya, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; D. Morita, Kao Corporation / Safety Science Research

Ready biodegradation studies (OECD TG 301) are required for registrations and the development of chemicals for various applications. Current test systems work well for many substances, but some substances, called “difficult substances” sometimes fail due to problems with these test systems. Here challenges and solutions in ready biodegradation studies are presented with water insoluble or/and volatile substances, as examples of “difficult substances”. A hydrocarbon, 15-methylpentane, is insoluble in water and tends to stay on the water surface. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the microorganisms could not access the test substance well on the surface water. To overcome this challenge, the test substance was wrapped in a nylon sheet so that it could stay in the water for access by the microorganisms. With this test system, the biodegradability was remarkably improved and it was regarded as ready biodegradable. This method and result were accepted by the Japanese authority. An aroma chemical, 3,5,5-trimethylhexanonic acid, is insoluble in water and tends to stay on the water surface and volatilize. An initial ready biodegradation study indicated that it was not ready biodegradable. It was hypothesized that this was because the test substance disappeared from the test system by volatilization. To elucidate this hypothesis, the concentration of the test substance and a possible hydrolyzed metabolite were monitored by chemical analysis in the water phase. The result indicated that the test substance volatilized within 48 hours. This result strongly suggested that the low biodegradation result was due to the rapid volatilization and disappearance of the test substance from the test system. The possible solutions to this challenge will be discussed in the presentation.

TI/285 Influence of inoculum origin and adaptation on biodegradation of emerging contaminants

B.A. Poursa, University of Amsterdam/IBED Institute / Institute for biodiversity and ecosystem dynamics; J. Dalmin, University of Amsterdam / IBED; M. Braster, VU University Amsterdam; R. Helmus, University of Amsterdam / IBED; R.J. van Spanning, VU University Amsterdam; P. de Voogt, University of Amsterdam / IBED; P. van der Parson, University of Amsterdam / IBED

Assessment of microbial biodegradation is a key parameter for estimating the environmental risk of new organic chemicals. Commonly used tests for the assessment of ready biodegradability (RBTs) have been designed as simple and inexpensive methods to identify chemicals that are not expected to be environmentally persistent in most of the ecosystems. However, RBTs suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. These tests are low throughput, space consuming and poorly reproducible. Moreover, the origin of the inoculum is also a cause of variability in RBTs results. Pre-exposure of the inoculum to the tested chemical prior to any test has been proposed as a method to improve biodegradability testing. Pre-exposure could allow a better persistence prediction of chemicals present at low levels in wastewater or of newly produced chemicals by including the natural adaptation ability of microbial communities. Therefore, in order to assess the influence of the inoculum origin and of pre-exposure on RBTs, we compare the biodegradation capacity of activated sludge from different Dutch wastewater treatment plants before and after pre-exposure to five different chemicals. Carbamazepine, diclofenac and metformin are commonly detected pharmaceuticals in wastewater, while 4-chloroaniline and N-methylpiperazone are industrial chemicals with erratic behaviour in RBTs. In this research, an effort is made to miniaturize the standard OECD 310 procedure. As this test requires large volume vessels, it is difficult to perform large scale tests with multiple inocula and contaminated soils, sealed bottles were used for the incubation and elimination is measured by following the CO₂ production (OECD 310) and the compound concentration by LC-MS/MS. The results of these experiments are expected to show differences between responses of inocula that are not pre-exposed. After pre-exposure we expect to reduce the risks of errors of test results and to enhance biodegradation. Different responses between the different inocula will give valuable information about the future environmental fate of the tested compound. Finally, this knowledge will develop more accurate ready biodegradation testing and lead to a more comprehensive environmental risk assessment of persistent chemicals.

TI/286 Investigations on the role of adaptation in OECD biodegradation screening tests

F. Miffon, C. Dick, Firmenich; K. van Ginkel, AkzoNobel; M. Seyfried, Firmenich

Until recently, adaptation was recognized by the European Chemicals Agency as one of the options in so-called enhanced ready biodegradation tests (RBTs) to provide proof of non-persistence of a test chemical. Since June 2017 (time of publication of the latest revisions of the test guidelines) adaptation has been explicitly excluded. This decision was presumably based on the concern of a perceived lack of capacity for adaptation in the natural environment but failed to provide scientific justification to generally put into question the environmental representativeness of lab results obtained from lower tier tests. As shown previously, positive results from enhanced RBTs are useful in persistence assessments and help avoid false negatives, usually resulting from the stringency of this type of tests. Based on previous results obtained from enhanced RBTs conducted after adaptation, we selected a structural family of compounds for which solid and reproducible effects were seen after adaptation with different inocula. One of the identified families was selected and after detailed review of the fate of adaptation. The outcome of this study will form the basis for further investigations on the environmental representativeness of positive results obtained from enhanced RBTs with adapted inocula.

TI/287 Use of Chemical Analysis to Enhance Interpretation of Biodegradability Tests: A Case Study with Two Gas-to-Liquid (GtL) Products

J. Dawick, G. Whale, C. Hughes, Shell Health / Risk Science Team

The Oslo Paris (OSPAR) Commission, which oversees the OSPAR Convention, currently implements the harmonised mandatory control system (HMCS) for use and reduction of discharges of chemicals in the exploration and production of oil and gas offshore in the Arctic. Chemicals must meet a Harmonised Offshore Chemical Notification Format (HOCNF) to implement the OSPAR member state authority to certify use of their products offshore. Marine biodegradability screening tests (BST’s) are an intrinsic part of offshore chemical control schemes and the HOCNF registration process. However, the lack of robustness of the marine biodegradation methods has been highlighted in a series of ECETOC workshops, particularly when these are used to assess complex, volatile and poorly water-soluble substances (e.g. petroleum products). We have found that the inclusion of abiotic controls and chemical analysis for total petroleum hydrocarbons (TPH) in freshwater BST’s demonstrates that disappearance of test substances from the test system is often far greater than is suggested by the results of standard biodegradation tests. Present results from two marine BST tests (OECD 306 and BODIS) conducted on two synthetic hydrocarbon Gas-to-Liquid (GtL) products. In addition to measuring ultimate biodegradation (by oxygen uptake) in these tests, additional analytical techniques have been incorporated to enhance the interpretation of results. Extraction and analysis of test samples using gas chromatography has been conducted to i) confirm substance dosing and ii) understand the extent of abiotic losses in the test system. In addition, two-dimensional gas chromatography (GCxGC) was deployed to characterise hydrocarbons present in test samples, which were compared back to the composition of the original test substances. An overview of the results and our recommendations on how marine biodegradability tests can be improved and interpreted will be provided.
biodegradability of various hydrocarbon solvents. SETAC Europe annual meeting 2015, Barcelona, Spain.

TU288 Organising an international ring test to improve the marine biodegradation screening test
Ali M. Parvis, T. Marken, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering
A series of international standardised tests have been approved by the OECD to measure the relative biodegradability of substances. Among these tests, biodegradation screening test (BST) form the first tier of assessment, offering relatively simple and cheap characterisations of biodegradability. Most parameters in these BSTs are highly prescribed and conservative, but the microbial inoculum is the least controlled parameter. The resulting high levels of variation have been recognised as a limitation since the introduction of these tests up to today and are especially reported for the marine BST OECD 306. BSTs were designed over two decades ago and are not, in their current form, effective as screens for persistence. In recent years, regulatory emphasis has shifted from identifying chemicals that are rapidly biodegradable to identifying chemicals that are potentially persistent in the environment. Technical guidance documents, which have been prepared under the European chemicals regulation system known as REACH, have suggested several improvements to effectively assess persistence with BSTs. Within their nature, these results in major enhancements also address a number of the commonly discussed reasons for high variability and poor reliability of BSTs. The Cefic LRI ECO11 project investigated and validated several enhancements for the marine BST. It was possible to represent the bacterial diversity in the sampled environment better by increasing the microbial inoculum to environmentally relevant concentrations through tangential flow filtration. This standardisation led to a significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRI ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.

TU289 Tissue-specific accumulation of triphenyltin compounds in marine fishes in southern Hong Kong
R.C. Sham, K.K. Ho. The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science
The extensive use of organotin (OT) compounds in antifouling paints and other industrial uses (e.g. as fungicides, wood preservatives, and antibacterial textiles) have resulted in major enhancements of these compounds in urbanized coastal marine environments. Even though the International Maritime Organization (IMO) of the United Nations enacted a global prohibition on the usage of organotin compounds in anti-fouling paints (4.48E13 g in 2002) from 2008, Hong Kong had not adopted any regulatory legislation to restrict the production, usage and release of these compounds until early 2017. High concentrations of these compounds, especially triphenyltin (TPT), are still being detected in the marine environment in southern Hong Kong. The study of TPT in tissue samples of marine fishes was conducted in collaboration with the Hong Kong University. The detected TPT concentrations were highly tissue dependent (i.e., marine fishes liver > muscle > brain). TPT was higher in fish species that were highly dependent on benthic invertebrates for their food. The comparison of TPT concentrations between different marine fish species provides important insights into the TPT distribution in marine fishes. The study also suggested that TPT concentrations in marine fishes could be used as an indicator of the presence of organotin compounds in marine environments.

TU290 Polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) in the Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
s. katakim, IIT Hyderabad; A. Qureshi, IIT Hyderabad / Civil Engineering; P. Chakraborty, SRM University; A.K. Tiwari, NCAOR / Polar environment
We present preliminary results on the occurrence of Polychlorinated biphenyls (PCBs) and Organochlorine pesticides (OCPs) in the terrestrial environment [moss, and water] of Schirmacher Hills, Dronning Maud Land, Antarctica, α-HCH concentrations (4.48E13 g in 2002) from 2008, Hong Kong had not adopted any regulatory legislation to restrict the production, usage and release of these compounds until early 2017. High concentrations of these compounds, especially triphenyltin (TPT), are still being detected in the marine environment in southern Hong Kong. The study of TPT in tissue samples of marine fishes was conducted in collaboration with the Hong Kong University. The detected TPT concentrations were highly tissue dependent (i.e., marine fishes liver > muscle > brain). TPT was higher in fish species that were highly dependent on benthic invertebrates for their food. The comparison of TPT concentrations between different marine fish species provides important insights into the TPT distribution in marine fishes. The study also suggested that TPT concentrations in marine fishes could be used as an indicator of the presence of organotin compounds in marine environments.

TU291 Degradation of crop protection products in Brazilian soils
B. Amaral, L. A. De Carvalho, A. C. N. de Souza, D. M. C. Reis, C. M. dos Santos, T. Martin, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering
A series of international standardised tests have been approved by the OECD to measure the relative biodegradability of substances. Among these tests, biodegradation screening test (BST) form the first tier of assessment, offering relatively simple and cheap characterisations of biodegradability. Most parameters in these BSTs are highly prescribed and conservative, but the microbial inoculum is the least controlled parameter. The resulting high levels of variation have been recognised as a limitation since the introduction of these tests up to today and are especially reported for the marine BST OECD 306. BSTs were designed over two decades ago and are not, in their current form, effective as screens for persistence. In recent years, regulatory emphasis has shifted from identifying chemicals that are rapidly biodegradable to identifying chemicals that are potentially persistent in the environment. Technical guidance documents, which have been prepared under the European chemicals regulation system known as REACH, have suggested several improvements to effectively assess persistence with BSTs. Within their nature, these results in major enhancements also address a number of the commonly discussed reasons for high variability and poor reliability of BSTs. The Cefic LRI ECO11 project investigated and validated several enhancements for the marine BST. It was possible to represent the bacterial diversity in the sampled environment better by increasing the microbial inoculum to environmentally relevant concentrations through tangential flow filtration. This standardisation led to a significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRI ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.

TU292 Study of the Degradation of Bisphenol A by the basidiomycete fungus Trametes versicolor, via HPLC-DAD-ESI-MS/MS
C.E. Gracio, V. Bianchi, P.G. Silva, A.C. Montini, E.C. Lima, C.L. da Silva, UFABC / CCNH
Bisphenol A (BPA) is a compound widely used in the production of polycarbonates and resins. Its use has been increasing in the last years and is a concern because of its potential to have adverse effects on human and animal health. Some studies connect the exposition to this compound to cancer and other diseases. In this work, it was evaluated the ability of the fungus Trametes versicolor (Institute of Botany of São Paulo) in degrading BPA by growing the mycelium in a enriched liquid medium and adding a Sigma brand pure BPA by growing the mycelium in a enriched liquid medium and adding a Sigma brand pure BPA. The mycelium was harvested at different times and the extracts were analyzed in an Agilent 1200 Series HPLC with DAD detector. The analysis revealed the presence of bisphenol A (BPA) and several other compounds. The results showed that Trametes versicolor is capable of degrading BPA and other compounds. The degradation products were identified and characterized using HPLC-DAD-ESI-MS/MS analysis. The potential of Trametes versicolor for the biodegradation of BPA and other compounds was confirmed. The study provides insights into the potential of Trametes versicolor for the biodegradation of BPA and other compounds.
In marine mammals, food is the main route of entry for contaminants. Their detoxification processes developed by marine mammals still be efficient – 40°C for the lighter PAHs. TOC content was found to be orders of magnitude higher than water extractions at 40°C and 80°C or in batch experiments. Additionally, batch unit (Dionex300) were executed, using acetone (potential leaching) quantifying the amount of PAHs which could be potentially and under almost real condition transport across the test substance (57 m/z). Satisfactory method performance was achieved at each incubation interval, as verified by recovery efficiency testing. The test substance, Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluides, dissolved to below 50% of the initial concentration over a 17-day period after the initial treatment (DAT) in all four soils evaluated in the study. From 17 DAT through 122 DAT the concentration of Paraffin Oil CAS (72623-86-0) produced by TOTAL Fluides, dissolved to 80-90% dissipated in all four soils evaluated. From 122 DAT through 300 DAT there was no substantial dissipation of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluides. However, the water extractions showed only light PAH concentrations (most abandoned light PAHs) than sediment extractions – methylnaphthalene, 2-methylnaphthalene, 2-phenanthrene, 2-anthracene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]pyrene and benzo[ghi]perylene were analysed by gas chromatography with mass detection. Additionally total organic carbon (TOC) and physico-chemical parameters (pH and TDS) were analysed. The batch experiments contained a potential concentration in the range of 0.01 - 36 mg/kg, the potential leaching concentrations ranged up to 36 mg/kg concentrations of PAHs were already reached. In general, light PAH concentrations had been reached in the sediment samples at times higher than heavy PAHs. Coal samples showed 4-times higher PAH concentrations (most abandoned light PAHs) than sediment samples. However, the water extractions showed only light PAHs. The batch experiments (3 samples per heap, 1 coal) showed only light PAHs in the water phase concentrations from 0.1 – 0.5 µg/L, with 2-methylphenanthrene (0.5 µg/L) in the coal sample. The highest concentration of total PAHs of a heap was found at the highest concentration of the lowest concentration found in the heap Victoria. Potential light PAH concentration in sediments (acetone extraction) were ca. 3 orders of magnitude higher than water extractions at 40°C and 80°C or in batch experiments. The extract at 80°C showed 20 times higher concentrations than at 40°C for the lighter PAHs. TOC content was found to be above 60% in coal samples (with 90% OC). Sediment samples showed TOC values in the range of 2% - 8%. Light PAHs from heaps have been found to be mobile, but may be immediately sorbed by natural TOC. However, dust emissions may pose a potential risk from heaps.

When ecotoxicology meets trophic ecology (P)

TI/205

Will detoxification processes of marine mammals still be efficient in the future? P. Mendez, Observatorio Pelagis; J. Spitz, Observatorio Pelagis Université de La Rochelle/CNRS; F. Caurant, Université de La Rochelle / LIENs

In marine mammals, food is the main route of entry for contaminants. Their concentrations can largely vary among prey species, for that reason differences in bioaccumulation will arise from differences in predator diet. Among all the contaminant that marine organisms faced, metallic trace elements (MTE) are natural substances that have been present on the earth since its formation. MTE can be divided in essential and non-essential in function of their biological role in the organisms. Low concentrations of essential elements can lead to deficiency effects. On the contrary, excess of non-essential elements (i.e. cadmium (Cd), mercury (Hg) and lead (Pb)) can induce toxic effects. However, their long-term presence in to the environment has allowed to marine mammals and other marine organisms to develop mechanisms to mitigate the potential toxic effects of these non-essential elements. The best known detoxification process is the demethylation of Methyl-Hg by Selenium (Se) forming granules of tiniemante (Hg:Se) in their liver. Today, anthropogenic activities induced a continuous increase of Hg concentrations in marine environment, altering the original quality of water and sediments. Such changes could affect the ability of marine mammals to control the negative impacts of their exposure to non-essential elements. Here, we investigated the temporal trends of Hg and Cd in liver and kidneys (main storage tissues) of 183 individuals of the smallest cetaceans species in the North Atlantic: the harbour porpoise (Phocoena phocoena). Both elements showed a significant increase (p < 0.05) of concentrations between 1999 and 2013. Notably, we highlighted a strong increase of the number of individuals exhibiting extreme values among the range of measured concentrations. In parallel, we analysed essential trace elements in 78 forage species (i.e. jellyfish, crustaceans, cephalopods and cartilaginous and bony fish) to assess their quality for predators. Results showed broad differences of their essential element composition. In particular, selenium of high interest can concern because of its long-range transported different species exposure among marine mammal species depending on their diet, which means that some of them could be less protected against Hg toxicity. Thus, changes in prey quality could have cumulative effects in cetaceans (increase of toxic elements and deficiency in essential ones) impacting the efficiency of detoxification processes in the future.

TI/206

Impact of biofilm growth on mercury accumulation in Daphnia magna s. issa, Norwegian University of Science and Technology; T. M. Ciesielski, Norwegian University of Science and Technology / Department of Biology; S. Einum, Norwegian University of Science and Technology / Centre for Biodiversity Dynamics CBD; Mikkelsen, Norwegian University of Science and Technology / Department of Chemistry; V. Jaspers, Norwegian University of Science & Technology / Biology

A largely neglected issue in lab-based toxicity testing of pollutants is the potential for other components in the biotic community to influence the effects of toxins on freshwater ecosystems. For example, biofilms commonly grow on aquatic surfaces as additional food for Daphnia. It can aso accumulate mercury (Hg), a pollutant of high international concern because of its long-range transport across the globe and its various toxic properties. As such, biofilm can play a central role in the transfer of Hg to higher trophic levels in freshwater ecosystems. By taking this into account, we can better predict effects of Hg in these ecosystems. Therefore, we conducted an experiment where single Daphnia magna clones were exposed at 20ÂC to 0.2 µg/L and 2 µg/L Hg (HgCl2) in the presence and absence of biofilm. Our main objective was to test for a significant effect of Hg accumulation in biofilm on Hg accumulation in daphnids. Results showed no significant effect of biofilm on Hg uptake in Daphnia. However, biofilm served as an additional source of selenium (Se) to daphnids, thereby increasing Se/Hg molar ratios in the animals. Thus, biofilm played a central role in the transfer of Se through the freshwater food web and in decreasing the risk from Hg toxicity in Daphnia.

TI/298

Multiple stressor effects on resource quality for consumers: a case study with phototrophic biofilm exposed to phosphorus and ionic silver M. Dangou, K. Sanchez-Thiron, LIEC, C. Crenier, LIEC Université de Lorraine CNRS; C. Hellere, Université de Lorraine; L. Malherbe, UPS INPT; A. González, Universidad de Las Palmas de Gran Canaria; F. Perrière, Université Clermont Auvergne; L. Ten-Hage, ECOLAB UMR CNRS UPS INPT; V. Felten, LIEC / LIEC CNRS UMR; J. Leflaive, ECOLAB UMR CNRS UPS INPT

Autotrophic biofilms are fundamental biological compartments of many aquatic ecosystems, representing notably a major resource for many important consumers. To date, most studies have tried to understand the impacts of stressors on microbial communities or on functional processes taking place into the biofilm mat. Far less studies investigated the indirect effects of stressors on upper trophic levels through alterations of the quality of biofilms. We investigated, through a laboratory study, the single and combined effects of phosphorus (P) availability and silver contamination on the elemental (C:P:N:ratios) and biochemical (fatty acid profiles) compositions of a diatom-dominated biofilm. We hypothesized that 1) P would enhance the elemental quality while 2) P and silver, through the replacement of diatoms by more tolerant primary producer species, would reduce the
biochemical quality of biofilms for their consumers. The quality of biofilms for consumers was assessed for a common crustacean species, *Gammarus fossarum*, by measuring organisms survival and growth rates. Results mainly showed that species replacement induced by both stressors affected biofilm fatty acid compositions, and that P immobilization permitted to achieve low C:P biofilms, whatever the level of silver contamination. Gammarids growth and survival were not significantly impacted by the ingestion of silver-contaminated resource. On the contrary, we found a significant positive relationship between the biofilm P-content and the gammarids growth, while biofilm fatty acid contents were unrelated to this parameter. This study underlines the large indirect consequences stressors could play on basal resources quality for consumers, and, in turn, on the whole food web.

TU299

Soil pollution induced changes in leaf litter chemical composition and in detritivore physiology and activity.

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In terrestrial ecosystems contaminated with high metal contents (brownfield), recent studies showed that, surprisingly, leaf litter decomposition process could be maintained despite deep changes in bacteria to fungal abundance ratio and invertebrate detritivore community structures. To disentangle the potential mechanisms involved in the path of the shift in decomposition under contaminated conditions, we conducted a decomposition study in soils from a silver (Ag) mine in France. We used birch litter (*Betula pendula*) produced on 10 sites along a metallic contamination gradient to assess the effects of the contrasted litter characteristics on microbial colonization and litter consumption by, the diplopod *Dendrobaena veneta,* as a model detritivore. Our results reported an impact of soil contamination on leaf litter chemical composition, leading in turn to significant impacts on diplopod physiology (in particular with an increasing oxidative stress when increasing Ag). We produced 2-fold higher than in non-supplemented animals (0.012 vs. 0.006 µg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burdens in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagy by the animal. These supplements could partly offset the risks when wheat-based diets are used. To reduce Pb exposure of livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.

TU300

Decomposition rates and feeding activity of soil fauna in relation with stages of plant colonization in mine soils of a Mediterranean area.


Organic matter decomposition (tea bag index) and feeding activity of mesofauna (Bait Lamina) were studied in an abandoned mine tailings area. Six environments were studied: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of Pinus halepensis trees (>5) ≤≈2.5 m high, growing scattered (P); 3. Isolated P. halepensis trees (>5) ≤≈2.5 m high, growing scattered (P); 4. Dense patches with several P. halepensis trees (>5) >≈4 m high and shrubs and herbs under the canopy (DP+MS); B) Outside the mine tailings: 5. Polluted forest with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF); 6. Control forest not contaminated with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF); 7. Control forest not contaminated with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF); 8. Control forest not contaminated with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF); 9. Control forest not contaminated with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF); 10. Control forest not contaminated with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF). The results show that the decomposition rates are higher in the soil of the mine tailings than in the control forest.

TU302

Analysis of anticoagulant rodenticides, neonicotinoids and fipronil in liver of predatory birds.


Pesticides in predatory birds have been drawing much attention worldwide in regard to species declining and protection. Pesticides are used for pest management of animal species such as commensal rodents and sap-sucking insects. However, pesticides can lead to secondary poisoning, when (predatory) take 5.3 g/kg Pb levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 µg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burdens in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagy by the animal. These supplements could partly offset the risks when wheat-based diets are used. To reduce Pb exposure of livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.
Spatial comparison of contamination and biomagnification profiles of TU305

forces for the zooplankton community, and zooplankton from the more freshwater biological (bloom) processes. Salinity and seasonality were major structuring abundances were higher in freshwater than marine dominated systems and salinity, was the major structuring force for phy.

analysed and trophic position and food origin was established with the help of met.

occasions in 2015/2016. Physical dynamics along a river dominance and productivity of the food webs, we aim to produce a food web model to assess the biomagnification of POPs in an apex avian predator, the Cooper’s hawk. Over 100 samples were collected from various trophic levels of the food-web including hawk eggs, songbirds, invertebrates, and berries. All samples were analysed for a number of contaminants listed as priorities for monitoring by the Chemical Management Plan of the Canadian federal government. Stable isotope analysis of δ13C and δ15N signatures of hawks, songbirds, invertebrates, and berries was used to estimate the trophic position of each organism. Legacy POP concentrations were expressed in terms of lipid equivalent concentrations to account for variability in the fractions of lipid and non-lipid organic matter measured in each sample. PFC concentrations were expressed in terms of protein equivalent concentrations to account for the fraction of protein within each sample, which was estimated as the product of the percent of nitrogen measured in each sample and a nitrogen:protein conversion factor. Censored regression by maximum likelihood estimation was used to assess the relationship between the natural logarithm of each lipid or protein equivalent product, versus trophic position. Trophic magnification factors (TMFs) were determined as the antilog of the regression slope. TMFs of legacy POPs ranged from 0.61 to 38.40, indicating that most legacy POPs are biomagnifying in this terrestrial food-web. TMFs of PFCs ranged from 11.8 to 544.6, indicating that PFCs are also biomagnifying in this terrestrial system and potentially at higher magnitudes than legacy POPs. Overall, terrestrial TMF values for POPs were determined for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems.

TU306 Sensational dynamics of zooplankton community, trophodynamics and Hg across a gradient from a DOM rich river to a marine system S. Schultz, University of Oslo; A. Ruus, NIVA / NIVA; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences; T. Andersen, D.O. Hessen, University of Oslo / Department of Biosciences; H. Veiteberg Braaten, O. Kaste, NIVA / Norwegian Institute for Water Research; A. Poste, Norwegian Institute for Water Research.

Recent increases in terrestrial derived dissolved organic matter (DOM) in freshwater (“browning”) and marine systems (“coastal darkening”) have been noted in several studies in boreal areas. This leads to the question if high riverine input of terrestrial derived material will affect the food web dynamics of recipient brackish and marine ecosystems. The presence of IDOM may affect light attenuation, primary production, and trophic interactions. Trophic interactions, nutrient cycles - all factors that may affect food webs in different manners, Terrestrial inputs can also directly and indirectly influence inputs, bioavailability and food web uptake of contaminants such as mercury (Hg). While several studies exist on effects of browning on productivity and community composition of freshwater systems as well as biomagnification of contaminants, there is considerably less known about OR DOM. This study was conducted in the Oslofjord, where we characterized physicochemical conditions, lower food web structure and Hg dynamics along a river- fjord continuum in southern Norway. Comprehensive water (surface and deep water) and zooplankton samples were collected on five occasions in 2015/2016. Physical-chemical parameters and nutrient concentrations were measured alongside data on chlorophyll a, bacterial as well as viral abundance and zooplankton composition. Methylmercury concentrations in zooplankton were analysed and trophic position and food origin was established with the help of stable isotope measurement (δ13C and δ15N). Naturalistic modeling, reflected in the salinity, was the major structuring force for physicochemical conditions in the system. DOC, TOC, total Hg and silicate concentrations reflected physical mixing of water from freshwater to marine. Overall bacterial and viral abundances were higher in freshwater than marine dominated systems and show clear seasonal patterns. Nutrients reflected both physical mixing patterns as well as biological (bloom) processes. Salinity and seasonality were major structuring forces for the zooplankton community, and zooplankton from the more freshwater influenced inner fjord appeared to have higher dietary reliance on terrestrial carbon sources than zooplankton from the outer fjord. We also found higher mercury concentrations in zooplankton from the more freshwater influenced sites, highlighting the importance of riverine Hg inputs for contamination of coastal biota.

TU307 Copper and mercury effective body residues in freshwater macroinvertebrates as related to benthic community metrics from a mining river basin. I. Alfonso, M. Mendez-Fernandez, University of the Basque country UPV/EHU / Zoology and Animal Cellular Biology; M. Martinez-Madrid, University of the Basque Country UPV EHU / Genetics, Physical Anthropology and Animal Physiology; N. Costas, I. Pardo, University of Vigo / Ecology and Animal Biology; P. Rodriguez, University of Basque Country / Zoology and Animal Cell Biology. Copper and mercury body residues in 10 macroinvertebrate taxa were used to model the alterations in benthic community metrics due to metal bioaccumulation in mining areas of the Nalon River basin (Spain). The studied taxa are potentially useful as water quality biomarkers and cover different functional feeding styles. This is part of a larger study in North Spain that aims to develop biota quality

TU305 Spatial comparison of contamination and biomagnification profiles of triphenyltin compounds in sub-tropical marine environments of Hong Kong R.C. Sham, K.K. Ho, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; X. Wang, Xiamen University / Department of Environmental Science and Technology; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science. Biomagnification of lipophilic organic contaminants is one of the major pathways to accumulate xenobiotic substances in marine organisms. Interestingly, the magnitude of biomagnification is not necessarily consistent in organisms across the marine food chain. Triphenyltin (TPT) compounds, which is moderately lipophilic (log Kow ~3.5), are commonly used in antifouling paints on sea-going ship hulls and superstructures, which are deployed in Chinese, Hong Kong, Japan and Taiwan. Studies have suggested that TPT can be biomagnified along the lower part of the trophic food chain (i.e., among primary producers, invertebrates, and fishes), while their magnification potential has remained unclear among the higher trophic organisms, such as larger fishes, dolphins, and seabirds. To date, only two studies have investigated whether TPT can be biomagnified along the marine food chain at higher trophic levels; however, their findings were contradictory. Therefore, we aimed to evaluate the biomagnification potential of TPT in high-trophic organisms across a spatial gradient from the more-contaminated western waters to the less-contaminated southern waters of Hong Kong. We have divided the western and southern waters into four sites, namely inner estuary (WI), outer estuary (WO), south of Lantau Island (SL), and southeast of Hong Kong Island (SE). Environmental (seawater and sediments) and biota samples (including molluscs, crustaceans, fishes and marine mammals) collected from the respective sites were analysed using gas-chromatography mass-spectrometry to examine the concentrations of six organotin compounds (i.e., mono-, di- and tri-butylin; mono-, di- and tri-phenyltin). Preliminary results showed that seawater samples from WO had high TPT concentrations. This is per TPT (F < 0.05) medium chain chlorinated paraffins (SCCPs and MCPPs, respectively), which quantitative assessment remain challenging. In the present study, we aimed at investigating the biomagnification of these compounds in the trophic web of an urban river heavily impacted by urban inputs: the Orge river (near Paris, France). In addition, a comparative study was performed, using polychlorobiphenyls (PCBs) as benchmark chlorinated hydrocarbons (i.e. positive drivers of biomagnification) and organotin compounds ranging from primary producers to piscivorous fish (n=35), were collected in this system and analysed for PCBs, SCCPs and MCPPs. Stable isotopes of nitrogen were used to estimate trophic levels and to compute TMFs using a Linear Mixed-Effects Model (lme) accounting for the difference of samples between taxa. Our results show the expected biomagnification of the targeted PCB congers (i.e. TMF > 1), thereby validating both the sampling strategy and the data treatment. SCCPs exhibited TMFs in the range 0.4–2.0 and the extent of biomagnification was directly related to structural features such as alkyl chain length and chlorine content. Conversely, MCPPs almost consistently displayed TMFs < 1, likely as a consequence of their higher biotransformation rates compared to SCCPs. Such results provide additional data for the risk assessment of chlorinated paraffins.
standards of several heavy metals, to contribute to water quality management to take forward the conservation of macroinvertebrate communities. The specific objectives of the study were: first, to model the relationships between 4 macroinvertebrate community metrics (number of families and abundance of EPT and PT), one multivariate (METI) and a predictive model (NORTI), using the Cu and Hg body residues as predictor variables; second, to assess Cu and Hg toxicity to benthic invertebrates through the estimation of effective body residues (ER); and third, to investigate the taxa-specific differences in metal ERs in relation to their feeding styles. The ERs were estimated for each taxon and metal from the best non-linear models, selected using Akaike's Information Criteria, and compared with the 90th percentiles (P90) of the data distribution in the reference sites of the study area, considered an approach to threshold (=no-effect) concentrations. The models were fitted for Cu and Hg but only in few instances for Hg. Results showed that Cu-ERr and Cu-ERi in 4 taxa (Baeotidae, Hydropodidae, Ephemerellidae and Microdrilii oligochaetae) were usually less than twice above the P90, calculated for the same taxa. These ERs in other 3 taxa (Heptageniidae, Ephemeridae, Rhyacophilidae) were mostly within the range of 2.1 to 5.0 times the P90. The largest ratios were found in ERi for Lumbricidae and Perlidae, which reached 12 times the P90 values. In the case of Hg, the predator taxa (Rhyacophilidae and Perlidae) and some of their potential prey, e.g. mayflies and simulids, showed ERs that were typically within the range of 1 to 3 times their respective P90.

TU308
Trophic transfer of Cadmium nitrate in a simplified marine food chain: experimental feeding rate of gelatious zooplankton Aurelia sp. and Sanderia malayensis on crustacean Artemia sp.
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Trophic interactions are a crucial vector of contaminant transfer in both aquatic and terrestrial ecosystems. In the marine environment, Cnidarian jellyfish are known to play an important role in food webs as major predators of zooplankton and as prey of apex predators, influencing the microbial loop, through direct and indirect effects, besides regulating the marine biogeochemical fluxes. In this study, the potential contaminant transfer was investigated in simplified marine food chains. The nauplii of the brine shrimp Artemia sp. and the ephyrae of Aurelia sp. and S. malayensis were selected as primary and secondary consumers, respectively. Cadmium nitrate was selected as toxicant. Performed experiments consisted in feeding ephyrae, every 24 hours for 5 days, with nauplii of Artemia sp. previously exposed, for 6 hours, to different concentrations (0.1-0.5-1-2-4 mg/L) of Cadmium nitrate; this range was selected through preliminary trials aimed to define the cadmium LC50 value for crustacean larvae. At the end of feeding experiment (5 days), the effect of Cadmium nitrate treated crustaceans on ephyrae jellyfish was investigated by the “ingestion rate method”, the “predatory performance” and biometrics and bioenergetics parameters (Disch diameter, ash-free dry weight_AFDD and gross growth efficiency_GGE). In addition, 24 hours after each feeding treatment, two ecotoxicological end-points were evaluated on jellyfish ephyrae: Immobilization and Frequency of pulsation (number of pulsations/min). Results showed a 100% of feeding rate and predatory performance in both control and treated jellyfish (A. aurita and S. malayensis). Cadmium nitrate treated Artemia nauplii, once ingested, caused in ephyrae a decrease of Disch diameter and AFDD and also an inhibition of GGE% (Aurelia sp.EC50: 3.82 mg/L). As regards ecotoxicological assays, immobilization was never affected (effect < 50%), while frequency of pulsation showed a significant decrease after each feeding treatment. These findings suggest a contaminant transfer from crustacean nauplii to ephyrae able to induce sublethal effects.

TU309
Tissular injuries in Cossartia virginica as evidence of the trophic transference of copper and cadmium via Chlorella sp.
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Exposure of metals to organisms in small quantities carrying out their biological functions. In contrast non-essential metals do not have a known biological function. When metals are incorporated by the organisms they can cause damage and their presence indicates contamination. Several human activities contribute to the increasing load of both essential and non-essential metals in the aquatic/ground environment. Microalgae such as Chlorella sp., are the primary link in the trophic chain. In this project, we want to use the environment, contact with the environment, they can incororporate contaminants by absorption or adsorption. If these algae accumulate contaminants, such as metals, the organisms that feed on them like the oyster Cossartia virginica can in turn incorporate them through filtration, which may have negative consequences. The objective of this work was to evaluate the effects derived from the trophic transfer of copper and cadmium from Chlorella sp. to C. virginica. Microalgae were cultured for 110 h at a sublethal dose of copper and cadmium (0.1 mg/L). A concentration of 30 X 10^6 cells was given to C. virginica for 21 days. The evolution of histopathological lesions in C. virginica was evaluated in days 0, 5, 10, 15 and 20 of the assay. The analysis performed in the digestive gland revealed diverse lesions ranging from the loss of cilia and covering membranes, to the increase in the light of the digestive gland tubules, as well as the presence of various inflammatory processes. Other organs such as the gills, presented inflammation and injuries that compromise the body's physiological processes such as feeding and breathing. These damages were evident after the first 96 h of exposure to the contaminated food. However, after 21 days of feeding the oyster with cadmium exposure, a non-essential metal, in more than 50% of organisms can be observed on day 10 and those associated with more than 50% of animals in cooper exposure were deferred to day 15. The presence of Chlorella sp. in the digestive tract made possible to associate the injuries with trophic metal poisoning, and the prevalence of lesions with metal exposure time.

TU310
Can microplastics save us? Effects of microplastic particles and particle-bound trace contaminants in an artificial aquatic food web
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Since 2015, studies dealing with toxic effects of microplastics in freshwater ecosystems come into focus. Still, little is known about vertebrate models as final consumers in food web experiments. The present study investigates the transfer of pristine microplastic particles and a model polycyclic aromatic hydrocarbon, along an artificial food chain with Artemia spec. nauplii and zebrafish (Danio rerio). Therefore, cryogenically ground microplastic particles, made of polystyrene (TU311
Toxicokinetics links predator-prey dynamics to assess zero-valent iron nanoparticles bioaccumulation in a Caenorhabditis elegans-Escherichia coli ecosystem
X. Yang, National Taiwan University / Bioenvironmental Systems Engineering; Y. Lin, National Health Research Institutes / National Institute of Environmental Health Sciences; H. Lin, National Taiwan University; C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; C. Liao, National Taiwan University / Department of Bioenvironmental Systems Engineering
BACKGROUND: Zero-valent iron (Fe0) nanoparticles (NPs) are one of the most paramount NPs applied in environmental remediation that the potential impacts on the ecological dynamics and soil ecosystem health are of great concern. OBJECTIVE: The primary objective of this study was to simulate dynamic models linking bioinorganic and consumer-resource dynamics in the Caenorhabditis elegans (E. elegans)-Escherichia coli (E. coli) OP50ecosystem. METHODS: The bioinorganic parameters, uptake and depuration rate constants of bacteria and worms were obtained from toxicokinetic experiments and related published literature. Biomass dynamics of bacteria and worms were estimated by employing the Lotka-Volterra model. Dynamics of Fe0NPs accumulations, bioconcentration factors (BCFs), biomagnification factors (BMFs) were simulated based on the consumer-resource dynamics. A sensitivity analysis was also performed to characterize the influence of consumer-resource-related physiological parameters. RESULTS: Results showed that biomass of worms increased steadily from 22.25–51.61 g L^-1, whereas the biomass of bacteria decreased rapidly from 17.17–2.29 g L^-1 and attained a steady-state after 2 h of the simulation in the scenario of 100 mg L^-1 Fe0NPs exposure. We also observed that internal concentrations of Fe0NPs were estimated to be 67 and 1768.85 μg L^-1 in worms and bacteria, respectively. In addition, the BCF of bacteria was found to be 17.69, close to the experimental results. Moreover, the BMFs of worms were maintained to be consistently smaller than 1 during 24 h exposure. Results also indicated that internal concentrations of Fe0NPs in worms were mainly influenced by biomass conversion rate for bacteria ingested by worms, whereas parameter of death of worms had the smallest effect on worm internal concentrations. CONCLUSIONS: Model application to toxicokinetic results confirms the hypothesis that the consumer-resource dynamics are effectively associated with Fe0NPs accumulations in bacteria and worms that the bioaccumulation kinetics and consumer-resource dynamics are likely to be dominated by the same physiological parameters.

Use of Effect Based Methods in the context of the national and european legislative framework for the protection of aquatic ecosystems (P)
TU312
INTEREST OF IN VITRO BIOASSAYS (YES/YAS) FOR THE SCREENING OF ENDOCRINE DISRUPTION IN SURFACE WATERS OF WALLONIA (BELGIUM)
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This study is part of the BIODIEN project. This project aimed at conducting, for the first time, a screening campaign of endocrine disruptors (ED) in waters of Wallonia (groundwater, surface water and wastewater). Almost 200 substances were screened, including hormone estrone, alkylphenols, phthalates, chlorophenols,

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perfluorates, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic and androgenic activities in surface waters. Antagonist activities were also evaluated. Over 71 river samples (concerning 24 river sampling points from the regional monitoring network), estrogenic activity was detected and quantified in 53 samples and could reach levels up to 11.7 ng E2eq/l (mean: 2.1±1.6 ng E2eq/l). Androgenic activity was detected. Of the other end, estrogenic and antagonist activities were detected in 42 % and 55 % of the samples, respectively. When the estrogenic activity is compared to the EU-Watch List Eqs for E2 (0.4 ng/l), 60 % of the samples exceed this value. The estrogenic activity was compared to the chemical results. A good correlation was found with the estrogen concentration but also with other ED (e.g. bisphenol A, perfluorates). This study is, in a way, the first attempt in Wallonia to follow the recommendations for the use of effect-based methods (EBM) for monitoring of estrogen in surface waters emanating from the Science to Policy Interface (SPI) Estrogen monitoring project. These recommendations were presented at the last EU-WG chemicals held in October 2017 and this would possibly lead to the introduction of EBM in regulatory monitoring under the Water Framework Directive (WFD), especially for estrogens.

TU313
Ecotoxicological tools to assess the impact pollution of tributaries to the Alqueva Reservoir (Southern Portugal)

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Degradation of surface waters and biodiversity loss at different spatial and temporal scales occurs through multiple stressors whose effects are difficult to separate and identify. Efficient management of water bodies depends on the development and selection of robust, sensitive and easily applicable tools that allow prioritizing the pressures and stressors that act in a basin, and mitigate their effects. The Alqueva reservoir constitutes the most important water supply source in southern Portugal, a semi-arid region with high levels of water scarcity and where agriculture is one of the main activities. The aim of the present study was to assess the use of an ecotoxicological tool box in tributaries of the Alqueva reservoir for detecting chemical alterations that may influence the water quality of the reservoir. Water samples were collected along 2017 at four tributaries of Alqueva (streams of Zebro, Alamos, Amieira and Lucefécit) and analyzed for: (i) physical chemical support elements (pH, temperature, dissolved oxygen, conductivity, chloride, total phosphorus, Kjeldahl nitrogen, ammonium, nitrite, nitrate, BOD, COD), (ii) hydrochemical and toxicological parameters (e.g. metals, cyanides, organics, oil and grease, dioxins and furans, using biotesters indicating different trophic levels (Vibrio fischeri, Thamnocephalus platyurus, Daphnia magna). In general, Zebro and Lucefécit presented concentrations of BOD (Zebro: 4.0-35.5 mg L\(^{-1}\); Lucefécit: 2.3-7.5 mg L\(^{-1}\)) and total phosphorus (Zebro: 0.18-6.23 mg L\(^{-1}\); Lucefécit: 0.02-1.92 mg L\(^{-1}\)) that compromise the biological life, with regard to nutrient and oxygenation conditions. High concentrations of phenols detected were low, being benzantone the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of benzantone of 1.94 mg L\(^{-1}\)), probably due to the intensive agriculture crops around it. Concerning to ecotoxicological analysis, the results highlighted the toxicity in sublethal parameters (reproduction, feed inhibition or growth inhibition) induced, mainly by samples from Zebro and Lucefécit streams. So, the results from the ecotoxicological tool box allowed identifying the streams that promote a higher chemical impact to the reservoir, which is essential to delineate management actions to improve the water quality of the reservoir.

TU314
Effects based tools for use in conjunction with passive samplers

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As part of an ongoing review of the Water Framework Directive (WFD), the European Commission (EC) is considering “effects based tools” (EBTs) for use as an alternative to the EW and to allow for consistent interpretation with, a list of assays for use in monitoring surface water concentrations. There are several ways in which EBTs may be integrated into environmental monitoring but one approach, which integrates chemical exposure over time, is to conduct toxicity profiling on extracts from passive samplers deployed in surface waters. The aim of this project was to provide a critical evaluation of available EBTs that could be used in conjunction with passive samplers, and propose a list of assays for use in monitoring surface waters associated with the oil and gas industry. A list of possible EBTs was compiled based on recent published reviews on this topic. These assays were then broadly screened based on commercial availability, general validation maturity, previous application to environmental samples, and suitability for use with passive sample extracts to derive a short list of 22 assays for more detailed consideration. The short-listed assays included novel whole organism bioassays (or surrogates), and in vitro or bacterial assays for endpoints based on endocrine disruption (oestrogen, androgen and thyroid), genotoxicity, oxidative stress, and metabolism of polyaromatic hydrocarbons (PAHs). Commonly used whole-organism assays (e.g. Daphnia magna, alga and invertebrate) were also subject to this screening, since they are already well proven and no detailed evaluation was required, however, were considered as part of the final recommendations. The shortlisted EBTs were then subject to a detailed review, based on the published scientific literature, to identify relevant information with respect to their performance, interpretation, and application. The EBTs were compared using the information identified in the literature review and an initial suite of thirteen bioassays were recommended for the monitoring of surface waters associated with refinery effluents using passive sampler extracts. This recommended suite of EBTs should be considered a starting point for use in the monitoring of waters receiving refinery effluents, to be further developed based on experience in using the assays for this purpose, and incorporating new relevant bioassays once they have achieved a sufficient level of validation maturity. This review will be published as a Concawe report in 2018.
(predicted no effect concentration). Ecotoxicological effects have been detected with the algae and could be related to the substances detected (e.g. heavy metals) or other substances released in the area (transitional waterbody). In general the results show a situation in which the quality of the sediments is not in a good status, although the level of concentrations should not cause a high risk for the aquatic ecosystems; the chemical contaminants can derive from different sources of pollution (industrial, urban, agricultural, atmospheric deposition) or untreated domestic wastewater to achieve the good quality status required by the water framework directive. The presence of Uranium in the marine coastal area should be further investigated to understand the possible role of the Coal fired power station.

TU317
USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROSOME ASSAY FOR THE IDENTIFICATION OF MUTAGENIC PROFILES IN WATER SAMPLES AND SUSPENDED PARTICULATE MATTER
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The Salmonella/microsome mutagenicity assay uses the genetically modified Salmonella enterica serovar Typhimurium bacterium, and the exploration of these different genetic characteristics allows the detection of various classes of mutagenic compounds. The objective of this study was to use different strains for the identification of mutagenic profiles and hinting at the class of compounds responsible for the detected mutagenicity. The research was performed with organic extracts of surface water and suspended particulate matter (SPM) collected in 13 different sites along the Danube River during the Joint Danube Survey 3 (JDS3). The extracts were evaluated with the Salmonella/microsome microsuspension assay and without metabolic activation (S9). The strains used were: TA98, YG1041, TA1538 and YG5185 with specific genetic characteristics for the detection of different compounds. A total of 69% surface water and 92% SPM samples were positive for at least one strain/condition. The applied methodology compared the profiles obtained at different sites along the Danube River. In this way, a wide variety of organic materials was examined on the basis of their mutagenic effects, that are causing mutagenicity. We conclude that aromatic amines and nitro compounds for surface water and also polyyclic aromatic hydrocarbons for suspended particulate matter appear to be responsible for mutagenicity at some of the sites, because the obtained profiles were similarly representative compounds of these classes. Other sites indicate the presence of other types of compounds or mixtures that are responsible for it. Non-targeted toxicological analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS The authors thank FAPESP Project 2013/16956-6 José Ricardo R. M. Zwarg thanks FAPESP Project 2015/11399-7 for the IC scholarship. Daniel A. Morales thanks CAPES for the PhD scholarship. The SOLUTIONS project has received funding from the European Union’s Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 603437.

TU318
NTA meets EPA: A practical example
J. Junke, V. Hinnenkamp, P. Balsaa, A. Simon, IWW Rheinisch-Westfälisches Institut für Wasserforschung GmbH, T.C. Schmidt, University of Duisburg-Essen Organic micropollutants play an important role in the assessment of water bodies that are used for drinking water production. On one hand, micropollutants pass through the wastewater system in sewage treatment plants and subsequently in surface water. On the other hand, there are direct discharges from industry and in addition, there are diffuse sources from agriculture, or from households, buildings and settlements. As major pollution events (i.e. PPC in the river Ruhr) show, water suppliers must always expect to find new critical substances that could pose a potential health risk in drinking water, especially when using surface water. For this reason, it is necessary to initiate a proactive screening of contaminants and their potential effects. Continuous monitoring by high-resolution mass spectrometry also makes it possible to analyze pollution retrospectively, gain knowledge about temporal dynamics and discharge patterns and thus identify the source of the contamination more frequently. In this context, a fast, robust and routine method for the determination of organic micropollutants is needed. This project is an approach to analyze organic micropollutants in water samples with a combination of non-target-analysis (NTA) and effect-directed-analysis (EDA). Samples were taken over a period of one year in order to obtain an annual progression of the water pollution. A LC IMS QTOF system was used to carry out the NTA. Different endpoints were analyzed for the EDA: cytotoxicity (MTT assay), endocrine activities (ER-CALUX and AR-CALUX) as well as genotoxicity (p53-CALUX, umuC assay and Ames assay). Due to the investigation of raw water samples, no significant biological effect of the individual samples was to be expected. The focus of this project was therefore on the identification and seasonal extraction trends of the micropollutant load. The coupling of NTA with a test strategy for toxicological effects forms an innovative approach with potential for preventive product quality assurance of the water supplier.

TU319
Imposex levels in gastropods from the Northern Adriatic Sea (Italy): a proposal of classification according to the Water Framework Directive
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Bythulins (BTs) - i.e. mono- (MBT), di- (DBT) and tributyltin (TBT) - are synthetic compounds worldwide used in industrial and agricultural applications giving rise to contamination of aquatic environments. Organotins, which include BTs, were banned on antifouling paints, the main route to aquatic pollution, by Reg. 782/2003/EC. Presently, due to their persistence, toxicity and bioaccumulative properties, TBT compounds are included among the priority hazardous substances according to the European Water Framework Directive (WFD) and its daughter Directive 2008/105/EC. Imposex, the superimposition of male sexual characteristics on females of gonochoristic gastropods, is the most studied effect of TBT pollution and it is generally recognized as a specific water quality and aquatic life impact. For this reason, under the implementation of the WFD, imposex measurements have been indicated as a useful tool to link chemical and ecotoxicological status assessment. In this context, the aim of this study was to propose a classification of imposex according to WFD using two species of gastropods collected in the Northern Adriatic Sea and in the Venice Lagoon: Nassarius nitidus (Jeffreys, 1857) - a marine and Propeamussium haliotis (Jeffreys, 1857) - a benthic, phytophagous, chemical and bio-morphological. The latter defines/locates connectivity and biodiversity in the ecosystem, since many aquatic organisms are independent on the ability to migrate during their life cycle. Water power represents a large/infraction (almost 50%) of electricity production within the country, and a large proportion of Swedish rivers are affected hydro-morphologically. At present, there are 11,000 active and/or abandoned dams in Swedish rivers, and 1,800 are hydroelectric power plants. All of these dams impact the ecological connectivity of rivers and have a negative impact on/biodiversity. In Sweden, a common national strategy is to use the increase of hydropower/plants as an alternative to reliance on fossil fuels. In the same time water power is the greatest individual cause of physical impacts in lakes and streams. The challenge at this/may/may stage of Sweden’s national energy strategy is to identify technologies and management practices that promote hydroelectric power with minimal long-term adverse/ecological impacts. To illustrate the challenges, this paper summarizes work conducted/unover the past 2 years to manage the future of the Sibro Dam located in southern-central/Sweden. The project was initiated after previous dam repair work involving the diversion of large/hydro work in the Sibro aims to protect and improve consequences for nationally Endangered/indigenous mussels and other aquatic life. The responsible municipality is obligated to improve ecological connectivity at Sibro Dam and regulation of Lake Båven. The planning/itwork included preparation of an environmental impact assessment (EIA), detailed/engineering design for fish passage, engagement with local communities and communications between the municipality of Nyköping and Sweden’s federal court/ins/fish passage; Sweden; ecological connectivity; environmental impact assessment

Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment (P)
TU321
Impacts of methylmercury on growth, respiration and swimming in larvae of a marine forage fish

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characterize endocrine disrupting effects of EE2 in coral reef fish, with an emphasis on social behaviors. For the exposure experiment, the fish were randomly distributed to separate tanks to form small colonies consisting of three individuals and were exposed to an environmental concentration of EE2 (30 ng/L) for 4 weeks. During this period, social behaviors including agonistic behavior, submissive response, and shelter utilization were videotaped and quantitatively analyzed once a week. Our results show that growth and survival were significantly affected by some antidepressants rather than EE2 treatment. Some behaviors were not altered, but social behaviors of the middle-ranked fish were significantly affected by EE2 suggesting that EE2 may cause different impact in different ranks.

TU324 Impacts of environmentally realistic antidepressant exposure on reproductive behaviour and sperm traits in fish
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Pharmaceutical contaminants are increasingly being detected in ecosystems worldwide. Indeed, more than 1 in 10 currently manufactured pharmaceuticals have been found in the environment. One pharmaceutical pollutant of environmental concern is the antidepressant fluoxetine, which has repeatedly been reported in aquatic ecosystems. Worryingly, the primary target molecule of fluoxetine in the wild through impairment of predation or avoidance of predators.

TU323 Effects of 17α-ethynylestradiol (EE2) on social behaviors of the false clown anemonefish (Amphiprion ocellaris)
T. Chen, National Museum of Marine Biology and Aquarium / Department of Biology; C. Lu, National Dong Hwa University / Institute of Marine Biology; C. Chen, National Taiwan University / Institute of Environmental Health

The synthetic estrogen 17α-ethynylestradiol (EE2) is extensively used in oral contraceptive pills, medication, cosmetics, and personal care products. It is also widely used in livestock and aquaculture farms via wastewater discharges and effluents of sewage treatment plants. EE2 is commonly detected in wastewater effluents and surface waters including coastal waters. Although coastal regions are often impacted by sewage discharges, no study has been done to address the effect of environmental estrogens such as EE2 in coral reef fish. Agonistic behavior is crucial for maintaining social hierarchy in many coral reef fish. Endocrine disrupting contaminants such as EE2 may interfere with social structure via disrupting their agonistic behavior. In this study, we aimed to use the false clown anemonefish (Amphiprion ocellaris) as an experimental model to characterize endocrine disrupting effects of EE2 in coral reef fish, with an emphasis on social behaviors.
TU326 Inter-species variability in the behaviour of a marine and freshwater amphipod
S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; A. Ford, University of Portsmouth / Biological Sciences; M.O. Parker, University of Portsmouth

Invertebrate species are used in standard ecotoxicology testing to assess environmental effects of contaminants. However standardised invertebrate models are limited to relatively few species. Behavioural ecotoxicology is expanding with techniques and endpoints used in pharmacology being translated to other invertebrate and invertebrate species for use in ecotoxicology. Despite this, data on the control behaviours of model organisms such as crustaceans, and the inter-species variability in behaviours are currently under-studied. The aims of this study were to provide control data on a range of behaviours for use in ecotoxicological testing, using amphipods as model organisms. Behaviours commonly associated with anxiety in pharmacological studies including activity, phototaxis (light/dark preference) and thigmotaxis (wall hugging) were assessed in the marine amphipod Echinogammarus marinus and the freshwater amphipod Gammarus pulex using choice assays. Both organisms exhibited negative phototaxis and positive thigmotactic behaviours (P< 0.001 respectively) however, differences in sensitivity to these assays were observed between species. E. marinus showed a significantly greater sensitivity to the phototaxis assay than G. pulex (P< 0.001), while the reverse was found for the thigmotaxis assay (P< 0.001). Swimming velocity was used as a measure of activity. Significant differences were observed in swimming behaviour between species when exposed to a light stimulus (P< 0.001) which may be attributed to differences in life histories between the two species. The results of this study provide evidence of phototactic and thigmotactic behaviours in two model crustacean species and describes two behavioural assays with potential for use in behavioural ecotoxicology. In this study we demonstrate that closely related species are capable of different behavioural responses. The inter-species variability in sensitivity to behaviour assays found between the two amphipods in this study highlights the importance of control data on your model species for behavioural studies.

TU327 Physiological basis of individual tolerance to the benzodiazepine oxazepam in zebrafish (Danio rerio)
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Pharmaceuticals are common contaminants in aquatic ecosystems. Among the most prescribed pharmaceuticals globally are the benzodiazepines (e.g. Valium), a class of psychoactive drugs used to treat anxiety and induce sedation. Benzodiazepines are persistent in the environment, and their target, the GABA-A receptor, is evolutionarily conserved throughout the vertebrates. Behavioural changes have been described for juvenile Eurasian perch (Perca fluviatilis) and Fathead minnows (Pimephales promelas) at environmentally relevant levels of oxazepam. We then correlated changes at low contaminant concentrations, and links individual- to population-level processes, it provides a sensitive tool for holistically assessing contaminant impacts. Here, we develop a conceptual framework that integrates effects of chemical contaminants on behaviour, under environmental relevance concentrations and natural contexts. Within our framework, we show how the consequences of contaminants can extend beyond individuals. We use altered predator-prey interactions to demonstrate cascading contaminant effects through communities, exerting both positive and negative effects on distinct populations. Moreover, contaminants can be potent evolutionary forces selecting directly for compensatory behaviours or indirectly on downstream behaviours, via selection on resistance genes. To help implement our framework, we supply tools to design ecologically realistic experiments and risk-assessments. Although predicting effects of contaminants is complex, existing knowledge in ecology and evolution needs to be applied to this global environmental challenge.

TU328 Reversible behavioural alterations in burbot, Lota lota, from exposure to environmentally relevant levels of oxazepam
J. Sundin, Norwegian University of Science and Technology / Department of Neuroscience; F. Jutfelt, Monash University / School of Biological Sciences; M. Thorlacius, Marine and Freshwater Institute; T. Brodin, Umeå University / Department of Ecology and Environmental Science

Benzodiazepines are frequently detected in standard ecotoxicology testing to assess environmental effects of contaminants. However standardised invertebrate models are limited to relatively few species. Behavioural ecotoxicology is expanding with techniques and endpoints used in pharmacology being translated to other invertebrate and invertebrate species for use in ecotoxicology. Despite this, data on the control behaviours of model organisms such as crustaceans, and the inter-species variability in behaviours are currently under-studied. The aims of this study were to provide control data on a range of behaviours for use in ecotoxicological testing, using amphipods as model organisms. Behaviours commonly associated with anxiety in pharmacological studies including activity, phototaxis (light/dark preference) and thigmotaxis (wall hugging) were assessed in the marine amphipod Echinogammarus marinus and the freshwater amphipod Gammarus pulex using choice assays. Both organisms exhibited negative phototaxis and positive thigmotactic behaviours (P< 0.001 respectively) however, differences in sensitivity to these assays were observed between species. E. marinus showed a significantly greater sensitivity to the phototaxis assay than G. pulex (P< 0.001), while the reverse was found for the thigmotaxis assay (P< 0.001). Swimming velocity was used as a measure of activity. Significant differences were observed in swimming behaviour between species when exposed to a light stimulus (P< 0.001) which may be attributed to differences in life histories between the two species. The results of this study provide evidence of phototactic and thigmotactic behaviours in two model crustacean species and describes two behavioural assays with potential for use in behavioural ecotoxicology. In this study we demonstrate that closely related species are capable of different behavioural responses. The inter-species variability in sensitivity to behaviour assays found between the two amphipods in this study highlights the importance of control data on your model species for behavioural studies.

TU329 Behavioural endpoints and biochemical biomarkers as tools to investigate effects of citalopram in brown trout (Salmo trutta f. fario)
M. Szczygier, University of Tubingen / Animal Physiological Ecology; S. Tisler, University of Tubingen / Environmental Analytical Chemistry; L. Reinelt, University of Tubingen / Animal Physiological Ecology; R. Triebskorn, University of Tubingen / Animal Physiological Ecology

Citalopram (CIT) is a selective serotonin reuptake inhibitor (SSRI) which is commonly used as an antidepressant. It binds to serotonin receptors for the serotonin reuptake from the synaptic cleft and thereby inhibits the reuptake of serotonin into the pre-synapse. Due to high concentration rates and moderate elimination during wastewater treatment, CIT is one of the most abundant SSRIs in surface water. Several studies showed that environmentally relevant concentrations of 1 µg/L may affect aquatic organisms. The aim of this study is to investigate effects of CIT in different life stages of brown trout (Salmo trutta f. fario) with a focus on development, behaviour and individual health. Both, eggs of the eyed ovary stage and 8 months old juveniles were chronically exposed to four concentrations of CIT (1, 10, 100 and 1000 µg/L) in a in a semi-static three-block design accompanied by a control exposure. The larvae were exposed for 5 month at 7°C and 11°C, the experiments with juvenile fish were conducted for 4 weeks at 7°C. To investigate the effects of CIT on the embryonic development, mortality, hatching rate, and heartbeat rate were recorded. During the exposure, also behavioural endpoints were observed. Besides, several biomarkers indicative for fish health were investigated, such as cortisol-level, acetylhemolisterase activity, hsp70-level and the histological condition of the liver. After exposure to 1000 µg/L CIT, length and weight of both larvae and juveniles were significantly reduced. Furthermore both stages showed an enhanced swimming activity and an increased swim up in the aquaria. In an artificial swimming measurement device (small aquaria with a diameter of 17 cm), videos were recorded for 20 minutes with the aim to quantify changes in the swimming behaviour. Due to the settings of the cameras, the aquaria were strongly illuminated and the water was not ventilated during the recording. This stress situation resulted in a high activity of fish exposed to 1000 µg/L CIT. These moved significantly less with a lower velocity than the control fish. The results of both experiments make evident that 1000 µg/L CIT affects both larvae and juvenile brown trout, on one hand by making them more agile in the aquaria, but also by depressing stress-induced floury swimming. The study is embedded in the Effect-Net (effect network in water research) Project which is funded by the Wassernetzwerk Baden-Württemberg.

TU330 Assessing the direct and indirect effects of chemical contaminants on the behaviour, ecology and evolution of wildlife: A conceptual framework
K. Arnold, University of York / Environment; M. Saaristo, Monash University / School of Chemistry; B.B. Wong, Monash University / School of Chemistry; C.P. Johnstone, Monash University / School of Biological Sciences; K. Arnold, University of York / Environment; M. Saaristo, Monash University / School of Chemistry; B.B. Wong, Monash University / School of Chemistry; C.P. Johnstone, Monash University / School of Biological Sciences

Although predicting effects of contaminants is complex, existing knowledge in ecology and evolution needs to be applied to this global environmental challenge.

TU331 Scents and sensibility: EE2 disrupts mate choice in fish
M. Saaristo, C.P. Johnstone, Monash University / School of Biological Sciences; K. Arnold, University of York / Environment; M. Saaristo, Monash University / School of Chemistry; B.B. Wong, Monash University / School of Chemistry; C.P. Johnstone, Monash University / School of Biological Sciences

Avoiding the handful of studies that have studied the behavioural effects of endocrine disrupting chemicals (EDCs), only a few have attempted to disentangle the mechanisms underlying behavioural changes, such as mate choice. In fish, for example, ecological studies have shown that males base their mate choice on
multiple cues and both visual and chemical cues play an important role in choosing the most suitable mate. Therefore, it is crucial to understand if and how EDCs affect mate choice cues (e.g. visual and chemical cues), and further, if one cue is affected disproportionately. Accordingly, the aim of this study was to investigate the impacts of a 28-days exposure to 17α-ethinyl estradiol EE2 (measured concentration 12ng/L) - a synthetic estrogen used in the contraceptive pill and a widespread compound of aquatic systems due to visual and chemical contamination in the gut. To examine the impact of EE2 on mate choice, we ran a standard choice assay, which was conducted in two parts to disentangle visual cues from chemical cues. First, we allowed a single male (either control or EE2) to court two size-matched females (one control and one EE2-female). In this visual cue-only experiment, the male was only able to see the females, but not to smell them. Second, we introduced chemical cues (control and EE2-female) to the trial tank. Pairing was done randomly with the females. We found that there was no significant effect of EE2-treatment on total time males spent associating with the females, when given only visual cues. There was, however, a significant effect on courtship ‘sight’ display with both control and EE2-exposed males spending more time performing sight displays for control females compared to EE2-exposed females. Males were presented with size-matched wild female guppies, control females, and EE2-females. In particular, neuroactive substances in the aquatic environment released by wastewater effluents into an alpine stream: are information on behavioural effects of EE2-exposure on chemical cues, but also raises the possibility that EE2-exposed males may be less successful in producing visual cues and mating. Our results underscore the importance of studying multiple mate choice cues simultaneously, and highlights the possible ecological implications of altered chemical communication for exposed wildlife.

TU332 Effects of tributyltin on the eyes, swimming, feeding and growth of newborn guppies Poecilia vivipara
D.V. Paulo, C.F. Mariz Jr, M.K. Alves, R.M. Barata, UFPE Universidade Federal de Pernambuco / Department of Zoology; R.N. Alves, UFPE Universidade Federal de Pernambuco / Zoology; P.S. Carvalho, UFPE - Universidade Federal de Pernambuco / Zoology.

Although the use of the anti fouling contaminant tributyltin (TBT) has been banned since 2008 by the International Maritime Organization, it still persists in coastal environments due to its remobilization from contaminated sediments and also as a result of illegal use, including tropical regions along the Brazilian Atlantic coast. Poecilia vivipara is a promising model for tropical estuarine fish ecotoxicological studies and we focused here on its feasibility to address fish early life stage toxicity caused by TBT. Newborn Poecilia vivipara fish at six days after birth (dab) obtained from a laboratory breeding stock were exposed for 96h to waterborne tributyltin at 0.1; 10; 4.5; 7 and 9 μg TBT L⁻¹ plus controls and solvent controls. After exposure, we evaluated swimming speeds and trajectories of the fish, counter-current swimming resistance, ability to capture Artemia nauplii, growth in weight and size, plus controls and solvent controls. In addition to these alterations, RPE invaginations, photoreceptor degeneration, iris epithelial cell atrophy and iris melanin condensation were observed. Tributyltin affected the eyes showed a darkening of the iris region after exposure to 4.5; 7 and 9 μg TBT L⁻¹. Histopathological analysis of the retinal pigment epithelium (RPE) indicated a hyperpigmentation of the pigment epithelium villi and basal region in TBT exposed fish. In addition to these alterations, RPE invaginations, photoreceptor degeneration, iris epithelial cell atrophy and iris melanin condensation were observed. No mortality or change in behaviour was observed in the two organisms under exposure to undiluted samples. Exposure to serial dilutions of the effluent caused mortality only in D. magna (15% of mortality after 24 hrs at 1:1000 dilution; 15 and 20% of mortality after 48 hrs at dilutions of 1:100 and 1: 1000, respectively). For the behavioural investigations, exposure to dilutions of the treated effluent indicated significant alterations of swimming parameters in both organisms (e.g., the time spent in activity in the different dilutions). In addition, the cumulative distance travelled in both at the exposure times. Overall, these findings emphasised a higher sensitivity of D. magna than D. cinerea gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.

TU333 Chemosensory behavioral reactions of zebrafish larvae to environmental contaminants
S. Haller, M. Hunger, C.M. vom Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology.

Background: Selecting an appropriate behavioral response to a potential rewarding or threatening stimulus is critical for the survival of an animal. Therefore, organisms possess an innate ability to react to threatening and rewarding situations they are naturally exposed to. However, the ability to naturally respond to environmental cues can be heavily affected by exposure to chemicals which can alter the underlying observed behavioral response. We aim to better understand how environmental contaminants change natural behavioral responses of fish in order to better predict their impact on the ecosystem. Methods: We are using zebrafish larvae as a model organism, because they are amenable for behavioral analysis and mechanistic dissection of complex processes. Larvae are exposed to a point source of test chemical at different concentrations and the behavior is tracked with an automated video recording system. Various parameters such as the larvae’s space use, locomotor activity and velocity are evaluated. Active swimming, swimming speed, swimming resistance, daily capture of Artemia nauplii and growth in weight were reduced by 85%, 60%, 20% and 20% of mortality after 48 hrs at dilutions of 1:100 and 1: 1000, respectively). For the behavioural investigations, exposure to dilutions of the treated effluent indicated significant alterations of swimming parameters in both organisms (e.g., the time spent in activity in the different dilutions). The cumulative distance travelled in both at the exposure times. Overall, these findings emphasised a higher sensitivity of D. magna than D. cinerea gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.

TU334 Do silver and titanium dioxide nanoparticles influence the fish kainomone induced anti-predator defence in Daphnia magna?
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Daphnia possess a trait of phenotypic plasticity, whereby kairomones from fish induce growth and the formation of structures such as a spine or helmet. The resulting increase in body size, allows the daphnids to defend themselves from the predators in their natural environment. As the common link between green algae and fish in the food chain, daphnia is considered a key component in the freshwater system. Therefore, we aimed to evaluate the effects of TiO2 nanoparticle exposure on behavioral and survival responses in Daphnia magna in order to test if exposure to TiO2 nanoparticles may affect the behavioral response of Daphnia magna to silver nanoparticles. The aim was to verify if D. magna could be employed in biomonitoring programs for WWTPs located in Alpine areas as surrogate of cold freshwater best adapted species. Mortality rate and behavioural responses (as swimming, analysed with two video tracking systems: LoliTrack System and Image3wNNTracker) were compared. No mortality or change in behaviour was observed in the two organisms under exposure to undiluted samples. Exposure to serial dilutions of the effluent caused mortality only in D. magna (15% of mortality after 24 hrs at 1:1000 dilution; 15 and 20% of mortality after 48 hrs at dilutions of 1:100 and 1: 1000, respectively). For the behavioural investigations, exposure to dilutions of the treated effluent indicated significant alterations of swimming parameters in both organisms (e.g., the time spent in activity in the different dilutions). The cumulative distance travelled in both at the exposure times. Overall, these findings emphasised a higher sensitivity of D. magna than D. cinerea gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.
are therefore of particular scientific interest, to establish what impact the MNMs are having on the freshwater cycle and food-chain. In our study, we investigate the effects of Ag (NM300K) and TiO2 (NM105) MNMs on the predator defence response; by chronically exposing *Daphnia magna* to fish kairromones and a range of nanoparticle concentrations. This experiment was conducted in accordance with OECD guideline No. 211 over a course of 21 days. For statistical analysis, we measured the body length, body width and tail spine length after each moult and consequently dynamic changes in swimming performance were observed in *D. magna*. A time interval is taken of each daphnid at the end of the experiment, to observe and compare the microscopic details of the anti-predator defences in the treated and untreated daphnia.

**TU336**

Behavioral and Physiological Responses of *Daphnia magna* to Fluoxetine and Propanolol Exposure

M.E. Nielsen, P. Rosley, Aalborg University / Biology and Environmental Science

Fluoxetine and propanolol are neuroactive human pharmaceuticals that occur as pollutants in surface waters. The potential effect of such pharmaceuticals on aquatic organisms including invertebrates has raised some concern but many adverse effects are not well characterized. In this study, 6 behavioral and physiological parameters in the freshwater Cladocoran *Daphnia magna* were compared for their responses to fluoxetine and propanolol exposure: mobility (dichotomous response), active swimming time, swimming distance, swimming velocity, swimming acceleration speed, and survival in the absence of food (starvation/survival). Changes in swimming behavior of *D. magna* were quantified by video tracking of single organisms followed by image analyses. Active swimming time and swimming distance appeared to be more responsive behavioral endpoints than swimming velocity and swimming acceleration. The EC50s for fluoxetine and propanolol determined from swimming time and swimming distance were comparable (1-2 mg/L). At low sublethal exposure concentrations (µg/L), nonmonotonic responses in swimming behavior were observed in D. magna. Behavior profiling estimated from multiple behavioral parameters showed that fluoxetine and propanolol stimulate swimming activity at 1-10 µg/L. EC50 values for fluoxetine and propanolol estimated from survival time in the absence of food (starvation/survival) were much lower than EC50 values estimated from changes in swimming behavior. Starvation survival is strongly affected by energy metabolism and we suggest that this parameter can be a potential sensitive endpoint for determining adverse effects of pharmaceuticals to *D. magna*. Combining behavioral and physiological responses to high and very low exposure concentrations should be considered in models predicting adverse effects of pharmaceuticals to non-target organisms.

**TU337**

How toxic is a non-toxic nanoparticle: Behaviour as an indicator of effect in *Danio rerio* (zebrafish) exposed to nanogold

T. Botha, North-West University / School of Biological Science; S. Brand, North-West University; V. Wepener, North-West University / School of Biological Sciences; H. Watt University for providing the food

Gold nanoparticles are used as drug delivery vectors based on the assumption that they have a low toxicity. Literature has however showed conflicting results over the last few years. This study aimed at investigating the toxicological effects of nanogold (nAu) over a range of indicators from sub cellular to whole organism level. Gene regulation, changes in oxidative stress biomarkers and swimming performance were assessed in *Danio rerio* (zebrafish) following exposures to nAu. Adult zebrafish were exposed to nAu for 96 hours. Swimming performance was measured post exposure. Liver tissue was collected for DNA microarray and Real Time Polymerase Chain Reactions (RT-PCR) analyses to determine changes in gene expression (catalase, superoxide dismutase and metallothioneins). Whole body samples were stored in respective buffers for protein biomarker analysis (catalase, superoxide dismutase, acetylcholine esterase, malondialdehyde, cellular energy allocation and metallothionein). Swimming behaviour was assessed in 1.1 L Tecniplast™ tanks for a period of six hours and videos were analysed using Noldus EthoVision software. The critical swimming speed was performed in a Lolog® swimming tunnel, briefly fish were acclimatized within the chamber for one hour and then swam at a starting speed of 2 b/s with a 0.5 b/s speed interval, fish were swum until they were unable to keep up with the increasing water flow. The DNA microarray revealed that 20 mg/L was the least related to the control group. At 20 mg/L there was a significant increase in gene expression for all genes analysed but protein biomarkers showed no significant response. The behaviour results showed significant changes in distance moved, swimming speed, acceleration bouts, zone altitudes and time spent within the top zone- responses which are seen in fish responding to toxicological stress. The exposed fish has a significantly lower critical swimming speed when compared to the control. Since swimming performance and social interaction during swimming is essential to life whole organism behaviour shows a toxicological response to nAu which is in agreement with genetic responses seen.

**TU338**

The effects of silver and silver nanoparticles via different routes of exposure on behaviour in marine amphipods

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Behavioural responses are an important endpoint because they provide a link between biochemical and ecological effects of environmental contaminants. Silver is increasingly being used in nanomaterials and, consequently, being released into the environment in different forms. The behavioural consequences of metal exposure in crustaceans remains unknown. Therefore, the aim of this work was to evaluate the effects on the swimming behaviour of the marine amphipod *Echinogammarus marinus* after exposure to silver, in its salt (AgCl and AgNO3) and nanoparticle (E. marinus (n=20 per treatment) were exposed individually. The exposure via water was performed with Ag (from AgCl for 25, and 100 µg/L for 96 hours. In the exposure via food the animals were fed on alternate days with control food or food impregnated with AgCl or AgNP (approximately 200 mg kg–1) during 7, 14 and 28 days. The movements of the amphipods were tracked using a DanioVision™ system with EthoVision®XT software for behavioural analysis under 3 minutes dark/3 minutes light cycle. Differences in velocity of swimming, response to light and thigmotaxis were evaluated. In the Ag exposure via water, light significantly increased maximum velocity for all treatments (p<0.05) indicating an escape-related behaviour; excepting at 100 µg/L–1, where the maximum velocity had no difference between lights off and on (p=0.110), showing that silver at this concentration had a significant effect on the response to light; no significant effects were observed in frequency in centre zone for all treatments (p>0.05), although, cumulative duration in centre zone was significantly reduced by 20 µg/L and AgNP, however, where animals spent more time in the centre zone when was dark. Results from the exposure via food are currently undergoing analysis. The current results indicate that silver has effects on swimming and response to light behaviours in *E. marinus*, indicating that exposed animals in the environment could be more vulnerable to predation. Acknowledgement: The authors thank Sao Paulo Research Foundation (FAPESP 2016/1963-4) for financial support. We also thank Professor Dr. Theodore Henry from Heriot-Watt University for providing the food (control, AgCl and AgNP) used in the feeding exposure.

**TU339**

New processing methods to determine aquatic invertebrate behavioural endpoints for regulatory ecotoxicology studies


Under current plant protection product (PPP) regulation, Tier I aquatic ecotoxicology studies measure mortality (acute) or reproduction (chronic). For invertebrates, these parameters are used to address the current protection goals of maintaining populations. Agreed guidelines for reproduction studies for aquatic invertebrates is currently not defined using a 25 mg/L *Chironomus*, however, for some substances, other taxa/species may potentially be more sensitive e.g. Ephemeropera, Plectoptera, Trichoptera (EPT) species. Currently, there are no agreed methods for measuring reproduction endpoints for non-standard test species, such as EPT species. EPT species often live as larvae for a prolonged period and have an aerial adult stage, and thus assessing reproductive endpoints from a full life cycle in the laboratory is not feasible. Therefore, if a Tier I method for a reproductive effects is desirable. Although behavioural endpoints (e.g. predator response, locomotion, feeding activity) do not directly relate to the protection goals of maintaining populations, they may still have a useful role in regulatory risk assessment. For example, for organophosphates (OPs) with steep dose-response curves and thus a narrow exposure window between acute and chronic effects, significant differences on reproduction can be due to mortality of adults rather than true reproductive effects; therefore, designing specific reproduction studies for e.g. EPT species may not be necessary for such substances. Instead, if a risk assessment were undertaken using acute and behavioural endpoints and acceptable risks were concluded, then it would be unlikely for effects at the population level to arise. Here we present our experimental assessment of aquatic invertebrate endpoints in one standard (*Daphnia magna*) and two non-standard (EPT: mayfly, caddis) test species that are suitable for use in regulatory toxicity tests, integrating the regulatory needs with the practicalities of ecotoxicology testing.

**TU340**

The effects of sublethal doses of pollutants on crop pest, *Spodoptera littoralis* and *D. sassafras*; Institute of Ecology and Environmental Sciences / Institute of Ecology and Environmental Sciences

Pesticides have long been used as the main solution to limit agricultural pests but their widespread use resulted in chronic or diffuse environmental pollutions, development of insect resistances and biodiversity reduction. The effects of low residual doses of these chemical products on organisms that affect both targeted species (crop pests) but also beneficial insects became a major concern, particularly because low doses of pesticides can induce various effects. In addition to the negative effects, some studies highlighted unexpected positive - also called...
hormetic - effects on insects, leading to surges in pest population growth at greater rate than what would have been observed without pesticide application. The present study aimed to examine the effects of sublethal doses of various representative products of large pesticide families used against a major pest insect, the cotton leafworm Spodoptera littoralis, and known to present a residual activity and persistence in the environment. Using an integrated approach from genes to behavior, we focused on the olfactory system as a sensitive and the sexual or feeding behavior of our crop pest model following application of sublethal doses of deltamethrin, methymol and chlorpyrifos. Whereas sublethal doses of methymol appeared to disrupt the feeding behavior of larvae, we demonstrated a hormetic response of males to sublethal dose of deltamethrin. We completed our study by molecular (qPCR), biochemical (proteomic, AChE activity and metabolic) and electrophysiological approaches in order to decrypt the involved mechanism in pesticide response as well as in the behavioral disruption.

TU341 The effect of copper nanoparticles on olfaction in rainbow trout (Oncorhynchus mykiss) P. Barea, University of Lethbridge / Department of Biological Sciences; E. Mohaddes, University of Lethbridge; E. Lari, G.G. Pyle, University of Lethbridge / Biological Sciences
Fish rely on olfaction for their survival, growth, and reproduction. Impairment of olfactory function can pose a threat to fish survival on the small scale and population loss on the larger scale. Metal contaminants (e.g. copper) can impair fish olfaction. Although the copper monomer Cu+ has low toxicity, whereas at least in acta toxicity, the impact of copper nanoparticles (CuNPs) on fish olfactory systems has not been well determined. The objective of this study was to investigate time-dependent effects of CuNPs and Cu2+ on olfactory acuity and olfactory-mediated behaviours of rainbow trout. To establish CuNPs or Cu2+ induced olfactory-impairment thresholds, inhibitory concentration (IC) curves were determined. Fish were exposed to a geometric dilution series of CuNPs or Cu2+ for 24 hours, and fish olfactory acuity was measured using electro-olfactography (EOG). Afterwards, fish were exposed to CuNPs or Cu2+ at concentrations known to impair olfaction by 50% (322 and 6.8 µg/L for CuNPs and Cu2+, respectively) for a 24 or 96 h exposure period. The response of fish to a social cue (taurocholic acid) was studied using EOG and a choice maze behavioural assay. After the behavioural experiment, fish olfactory rosettes were dissected to investigate if there was any DNA fragmentation as a marker of apoptosis that might be induced by CuNPs or Cu2+. Results of EOG revealed that while a 96 h exposure to CuNPs caused a significantly greater impairment of fish olfactory function relative to a 24 h exposure to the same concentration, fish olfactory acuity partially recovered after 96 h. CuNPs continued to impair olfactory acuity at concentrations known to impair olfaction by 50% (322 and 6.8 µg/L for CuNPs and Cu2+, respectively) for a 24 or 96 h exposure. Behavioural responses of rainbow trout to the social cue supported the results of neurophysiological experiments. Although fish exposed to control water or Cu2+ for 96 h had an avoidance response to an alarm cue, those exposed to the CuNPs did not respond to the alarm cue. Results of DNA fragmentation indicated apoptosis was not the mechanism of olfactory toxicity for CuNPs or Cu2+ in the exposed fish. In summary, over the same exposure periods, Cu2+ and CuNPs at concentrations known to impair olfaction by 50% (322 and 6.8 µg/L for CuNPs and Cu2+, respectively) for a 24 or 96 h exposure, partial olfactory recovery was documented for Cu2+ exposure. However, the mechanism of olfactory toxicity caused by CuNPs is not clear and needs further investigation.

Informed substitution of hazardous chemicals for circular economy: science and practice (P)

A survey campaign has been carried out to determine the concentrations of twelve perfluoroalkyl acids (PFAA) in liquid wastes, before the disposal in dumpsite or incinerator. The common characteristic of these wastes was that they were classified as “wastes without dangerous substances” and could be disposed of without specific treatments. Waste samples (about 120) came from solid waste treatment plants, drinking water and isolated sewage treatment plants, landfill leachate, solid waste storage facilities, car washing, septic tanks, laundry sludge and wastes from various industrial plants such as paper, food, wood, furniture, glass and pharmaceutical industries. The large spectrum of activities allows us to get a particularly rich data to be further used in the economic sectors and to evaluate the environmental impact of the different sources. The percentage of samples which presented total PFAA concentrations greater than 1 µg/L was 65%. The maximum concentration measured was 900 µg/L. As regards the single congeners, the percentage of positive samples (i.e. > 0.05 µg/L) ranged from 5% to 37.5% for the different compounds. It is very important to note that PFOA and PFOS were found only in 5% of the samples, while the highest findings were for PFBA (57%) and PBBS (37.5%), highlighting the increasing diffusion of short chain PFAsA respected to the already restricted C8-PFAsA. It is also interesting to note that one of the samples with the highest concentrations was found in the pharmaceutical industry, and it was an aqueous washing solution of water ligurs. The overall survey underlines the need for a more accurate characterisation of wastes and the risk of transferring PFAA pollution from production sites to disposal sites, which can be located also in no-impacted areas.

TU343 Regenerated Textile raw materials: chemical contamination for LCA A. Franchi, Buzzi Laboratorio Analisi
It’s essential, for every actor involved in the supply chain of a textile company, to increase awareness that a regenerated material requires proper and specific evaluation standards. These should ensure compliance with private protocols and mandatory laws and also a correct disposal and re-utilization. ICD (Italian Consortium for Detox Implementation) with the support of local actors (chemical laboratories) made a study concerning chemical contamination of regenerated materials in order to propose a PRSL (Product Restricted Substance List) for regenerated and recycled textile materials. The adoption of a PRSL for regenerated textiles would guarantee the safe re-use of these materials as an alternative to their disposal. This case study takes into account regenerated woolen textiles (high wool content > 70%) derived by post-consumes materials (knitted apparel, apparel made up by carded woven and combed woven), pre-consumes materials (combed and carded woven, knitted fabrics, spinning and twisting trimmings), and regenerated cotton-type materials (derived from denim recycling).

Operational plan involved quantitative and qualitative assessment concerning the degree of the raw material usage. The PRSL is composed by 92 materials (about 120) came from solid waste treatment plants, landfill leachate, solid waste treatment plants, drinking water and isolated sewage treatment plants, landfill leachate. These textile samples are typical for their wide range of materials composition and their specific treatments. Waste samples (about 120) came from solid waste treatment plants, landfill leachate, solid waste treatment plants, drinking water and isolated sewage treatment plants, landfill leachate. The common characteristic of these wastes was that they were classified as “wastes without dangerous substances” and could be disposed of without specific treatments. Waste samples (about 120) came from solid waste treatment plants, landfill leachate, solid waste storage facilities, car washing, septic tanks, laundry sludge and wastes from various industrial plants such as paper, food, wood, furniture, glass and pharmaceutical industries. The large spectrum of activities allows us to get a particularly rich data to be further used in the economic sectors and to evaluate the environmental impact of the different sources. The percentage of samples which presented total PFAA concentrations greater than 1 µg/L was 65%. The maximum concentration measured was 900 µg/L. As regards the single congeners, the percentage of positive samples (i.e. > 0.05 µg/L) ranged from 5% to 37.5% for the different compounds. It is very important to note that PFOA and PFOS were found only in 5% of the samples, while the highest findings were for PFBA (57%) and PBBS (37.5%), highlighting the increasing diffusion of short chain PFAsA respected to the already restricted C8-PFAsA. It is also interesting to note that one of the samples with the highest concentrations was found in the pharmaceutical industry, and it was an aqueous washing solution of water ligurs. The overall survey underlines the need for a more accurate characterisation of wastes and the risk of transferring PFAA pollution from production sites to disposal sites, which can be located also in no-impacted areas.

TU344 Challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing. Two case studies: flame retardants and durable water and oil repellents N. Fuentes, J. Damasio, V. Gonzalez-Andres, M. Diez-Ortiz, G. Janer, Leitat Technological Center
Chemicals used in textile finishing processes are known to be toxic, persistent and bioaccumulative. Indeed, some of them (e.g., PFOA and DecaBDE) are listed in the Authorisation list and will be restricted after the sunset date. Alternative products are currently proposed by chemical companies for textile applications. Here we present two case studies (FLAREX and MIDWOR projects) focusing on the substitution of hazardous substances used as Flame Retardants (FRs) and Durable Water and Oil Repellent (DOWRs). FRs are added to fabrics to inhibit the combustion process, and typically are products with a chemistry based on halogenates. DOWRs are added to fabrics to repel water, oil and dirt, and typically are products with a chemistry based on long chain fluorocarbon polymers. These projects aim to support industry in the selection of alternatives. Alternative finishing additives available on the market were selected for laboratory validation of technical performance and industrial demonstration. In addition, a comparative risk assessment of conventional and these alternative formulations should be provided to ensure the reduction of environmental and human health impacts. One of the main challenges for a comparative risk assessment of these products is that the active substances in most of them are polymers and therefore are not subject to registration under REACH regulation. The potential human and environmental impacts of these materials are related to their content or possible release of monomers (both with limited information). Moreover, the commercial formulations offered by chemical companies do not provide detailed composition. In fact, in the commercial products evaluated the chemical identity of the active substance was not reported in the safety data sheet. This is due to the lack of obligation to report ingrediemts from non-regulated substances. Under this scenario, we propose to base the comparative risk assessment on the toxicological profile of the chemical family of corresponding monomers (based on the information supplied by the providers), and the operational conditions necessary for the application of each of the products (assuming that the risk mitigation measures will not change within an industrial setting). The results will support industry to select functional and safer alternatives.

TU345 Substitution of firefighting foams containing per- and polyfluorinated alkyl...
substances (PFASs) A. Bieigel-Engel, German Environment Agency - UBA / Chemicals; L. Viete, C. Stauder, German Environment Agency / Chemicals Per-and polyfluorinated alkyl substances (PFASs) are heat resistant and show a low friction resistance. Because of these properties PFASs are for example widely used in aqueous film forming firefighting foams (AFFF). PFASs are not degradable in the environment. This is due to the Affinity of AFFF into the environment causes a compound. Low chain PFASs (such as PFOS and PFOA) need years to leach from top soil layers into the groundwater or into surface water. Short chain PFASs however reach ground water resources much faster due to their mobility in soil. Those contaminations already caused closed drinking water wells. Remediation is costly and long lasting. Although fluorine free foams are available and used at several European airports many firefighters hesitate to use them instead of AFFF. Restriction and authorization are regulatory measures under REACH which can be used to minimise releases of PFASs into the environment. An international regulation via the Stockholm Convention is possible as well. In addition the dialogue with stakeholders can be lead to voluntary actions and may be an alternative measure to reduce environmental releases. Scientists and manufacturers need to be encouraged to develop environmentally friendly firefighting agents without fluorinated chemicals. Moreover, scientists, authorities and NGOs need to bring together knowledge about the new substances, such as analytical methods, and information on their fate and behaviour in the environment. This presentations provides an overview on regulatory actions regarding PFASs in the EU and further ideas how to substitute firefighting foams containing PFASs.

TU346

The Paradigm of Substitution - expand your view M. Zimmer, ZVO e.V.; M. Metzner, Fraunhofer Gesellschaft

Many people mention substitution as the most promising option for risk reduction in the area of SVHCs. But it has to be considered that technical solutions are already embedded into complex structure-effect relationships along of equally complexity. Many different properties and outcomes have to be considered. Otherwise a thorough assessment of the applicability of an assumes alternative will fail. The surface treatment sector as a major cross-sectorial community of service providers has long term experience with innovation and substitution suggested by different players for many different reasons – risk reduction being one of them. In particular the SMEs have constant been confronted with lots of different ideas and approaches. Hence they have deep insight into unexpected side effects and regrettable outcomes. And they are able to give indicators for real promising and applicable approaches to substitution. The authors will present some significant examples of substitution attempts – and they discuss arguments why they might be considered successful – or not.

TU347

A pilot case on how Socio-Economic Evidence can inform Risk Management decision making to assess Substitution versus Recycling for non-ferrous metals slags in safe use applications H. Waertenshoot, M. vander Straeten, Eurometaux

The implementation of the European Circular Economy policy leads to more recycling, including closing the loop on substances. This policy combined with the increasing complexity of articles leads to increasing amounts of hazardous substances and impurities being available for recycling or reuse. Recycling processes in the metals sector produce besides pure substances for safe reuse, also final slags that collect some of the impurities that cannot be recovered at economically conditions. In parallel, the human health and environmental effects data generated by EU REACH and CLP Regulations lead to increasing hazard identifications and harmonised classification conditions. Hazard endpoints of Very High Concern like CMR (carcinogens, mutagens and reproductive toxicity) or respiratory sensitisation may trigger substitution-based Risk Management Measures but also reduce the reuse in safe applications for “precautionary reasons”. In such cases, socio-economic evidence may be helpful to assess costs and benefits from a broader perspective, including Circular Economy and carbon footprint considerations. A pilot study conducted at a non-ferrous plant specialised in the recycling of complex end-of-life articles and materials allowed to evaluate this impact and develop a tool for assessors to check how to what extent a change in a relevant hazard classification could impact the reuse capacity of final slags. This tool allows metal companies to assess their situation in respect to Substitution (materials loss or disposal) versus Reuse in safe applications.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiochemicals and botanicals (P)

TU348

Ecotoxicology of the hydrolate byproduct of three biopesticides on the unicellular green algae Chlamydomonas reinhardtii D. Ballesteros, J. Val, E. Langa, San Jorge University; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; M. Piñ headset, J. Val University / Facultad ciencias de la salud; A.M. Maimar, Universidad de Zaragoza

Synthetic pesticides have been widely used in intensive production systems throughout most of the 20th century. However in the last decades, environmental and human health concerns demand safer substances, so research on biopesticides has been increased. Although a large number of studies have been published focusing on the biological activity of biopesticides on target organisms, studies regarding toxicological effects on non-target organisms, are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) has allowed the screening of several plant extracts for bio-activity against a selected set of crop pests and aphrodes vectors. Some of these compounds have showed its effective value as biopesticides. The extracts will be optimized by means of traditional and supercritical CO2 technologies, as well as microbiological transformations. In the extraction process the organic and the aqueous fraction (hydrolates) have been separated and some showed active compounds, being capable to act as biopesticides. In order to exclude a negative effect on the environment, these products should be studied on non-target organisms. The aim of this study was to measure the acute ecotoxicity of hydrolates obtained from the semi industrial vapor-pressure essential oil extraction of three selected aromatic plant species; a domesticated Artemisia absinthium (Terveal, Spain), Dittrichia graveolens (Ciudad Real, Spain), and an experimentally pre-domesticated Lavandula luisi (Toledo, Spain) using the algae Chlamydomonas reinhardtii as aquatic model organism. Results indicate that all of these extracts having biopesticide activity are likely to cause toxic effects on the photosynthesis of Chlamydomonas reinhardtii, being Lavandula luisi the most toxic compound followed by Artemisia absinthium with a very similar toxicity and Dittrichia graveolens. Consequently, the aim of this study is to assess a better understanding of the safety that natural crop protectants can play in the aquatic environments. Acknowledgements: We thank J. Burillo and J. Navarro for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R).
on soil non-target organisms (microbial community and earthworms). Soil microbial communities from an ecological farming crop have been exposed to three hydrocarbons, obtained by semi industrial vapor-pressure essential oil extraction, from three aromatic plant species: Artemisia absinthium, Dictyrrhachis graveolens and Lavandula latissima. The effects on the microbial community has been assessed using the community-level physiological profile –CLPP-. This method relies on the ability of a microbial community to degrade different carbon sources present in Biolog Ecoplates®. The toxic effects of the hydrocarbons were also tested by Eisenia fetida bioassays. Results indicate that hydrocarbons caused acute adverse effects in E. fetida, in particular D. graveolens and A. latissima (LC50 in the range of dilution of 10-2). All three bioprodices provoked changes in the soil microbial ability to degrade different carbon sources compared to control. These results allow for a better understanding of the impacts of natural crop protectants in the soil environment as a pest management alternative. Acknowledgements: We thank J. Burillo and J. Navarro for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R).

TU351
Acute toxicity of emulsifiable concentrate of Alpinia galangal essential oil against Cyprinus carpio

H. Kim, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee. Kyungpook National University Essential oils have exhibited their fumigational and topical toxicities on insect pests and they are developed as safe bioprodices. However, their use may be caused potent toxic effects to non-target organisms in the environment. It needs to be determined whether the efficacy of the EC may be transferred to the aquatic organisms. Alpinia galangal essential oil (AGEO) has been considered to control the outbreak insect pest, Rictina sp. in South Korea. Acute toxicities of AGEO against Cyprinus carpio were assessed to understand its possible toxic effect on the representative aquatic organism. Cyprinus carpio in a static condition followed by OECD guideline 203 in 5 L beakers. As AGEO's were formulated for emulsifiable concentrate, a 1% solution was prepared in ethanol with the surfactant and tergitol in a ratio of 5:1:1. Tergitol is a surfactant and it did not show any toxic effect on the fish, so that it was used for the formulation of emulsifiable concentrate for AGEO. Three different AGEO's were prepared according to their extraction methods as steam distillation, solvent extraction and supercritical fluid extraction. After the EC formulation was prepared, they were ready to expose to C. carpio to determine LC50 values. All emulsifiable concentrates of three different AGEO showed no mortality on the tested fish during 96-hour incubation. Therefore, 48-h LC50 values for the VFEO were under the toxicity criteria of level 3 for the pesticide to C. carpio standardized by Korea Rural Development Administration. Based on these results, AGEO can be considered to use as a natural insecticide.

Understanding human and environmental exposure to chemicals in urban systems (P)

TU352
Chronic toxicity of emulsifiable concentrate of cinnamon essential oils against Cyprinus carpio

H. Jeon, K. Kim, H. Kim, Y. Choi, Y. Kim, S. Lee. Kyungpook National University Recently, many researchers have developed natural insecticides to control insect pests using plant essential oils (EOs) due to their eco-friendly properties. Cinnamon EO is one of important EOs to be a potent candidate and is formulated as an emulsifiable concentrate (EC). As its use is recognized as safe, it needs to be determined its negative effect on the environment using bioindicators. To evaluate the negative effect on the ecosystem, chronic effects of cinnamon EOEC against Cyprinus carpio was determined in a static condition for 40 days. When cinnamon EOEC was used as an active ingredient, they were mixed with ethanol and tergitol as surfactants. To select an appropriate surfactants, 8 different types of surfactants (TWEEN 80, Sodium dodecyl sulfate (SDS), Nondient, Triton X-100, Sodium dodecyl Benzene Sulfonate (SDBS), Koliphor, Tergitol and Mixture of SDBS and Nondient) were tested for the formulation and tergitol showed the lowest toxicity to the fish in an acute toxicity test. With the result of the acute toxicity of cinnamon EOEC, chronic toxicities of cinnamon EOEC was determined at the 5 different concentrations for 40 days. Each concentration was triplicate exposed to 10 of C. carpio adults. The treated five concentrations were 0.08, 0.16, 0.64, 2.56, and 5.12 ppm and the mean survival rate was 8.48 ± 0.7. The survival rate of the control group was 9.33 ± 0.58 and the positive control containing ethanol and tergitol was 8.00 ± 1.00. The mean temperature and pH of the test was 24.06 ± 0.58 °C and 7.51 ± 0.03, respectively. The mean of dissolved oxygen of the test water was 7.29 ± 0.07 mg/L and the mean of hardness was 82.14 ± 2.04 mg/L. After the complete exposure, the mean of length of adult was 3.00 ± 0.17 cm and the weight was determined as 0.37 ± 0.17 g. With these results, cinnamon EOEC may be considered as safe, natural insecticides for the environment.

TU353
Thiosemicarbazone scaffold for the design of antifungal and antiflavatoxigenic agents: evaluation of ligands and related metal complexes

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Food safety is the safeguarding and protection of food from anything harmful affecting consumer health and is an extremely important issue facing the world. Food hazards can be divided into physical, chemical and biological. Examples of biological hazard are mycotoxins, that are toxic secondary metabolites produced by many species of filamentous fungi. Generally, mycotoxins represent a significant threat to human health as they can be carcinogenic, neurotoxic and toxic to endocrine or immune system. In particular, aflatoxins are a class of mycotoxin produced principally by two species of Aspergillus, A. flavus and A. parasiticus. Aflatoxins are found in various cereals, oil seeds, spices and nuts as a result of a fungal contamination that can occur in the field, during harvest, transport and storage. IARC has classified aflatoxins in Group 1 as carcinogenic agents to humans. The most dominant and potent aflatoxin is aflatoxin B1 and several studies indicate that high exposure to AFB1 can cause chronic toxicity and increases the incidence of hepatocellular carcinoma. A lot of methods can be applied to eliminate these toxins from food and guarantee the food safety and health concerns of consumers. Our research aims to develop new typologies of inhibitors of Aspergillus proliferation and of aflatoxin production, harmless to the environment and to human health. We have evaluated the biological activity of several thiosemicarbazone ligands starting from molecules of natural origin, like vanillin, perillaldehyde and their derivatives. In order to improve the biological activity, metal complexes were then synthesised. These molecules once synthesized and characterized, were initially tested to determine their antifungal and antiaflatoxigenic activity towards A. flavus. These compounds showed different efficacy in reducing fungal growth and mycotoxin accumulation. The most active compounds were used to perform cyto- and genotoxicity tests on healthy human cells, particularly on human cell lines deriving from the districts that can be exposed to xenobiotics. Furthermore, we performed toxic and genotoxic assays on bacteria and plant cells. In conclusion, this approach allows us to study the antifungal and antiaflatoxin activity of several thiosemicarbazones and to determine the potential risk for environment and human health with a view to use these compounds in field. Financial support: Fondazione Cariplo-Project N. 2014-0555, http://aflatox.unibs.it/
plasticizers. Our results indicate that participants are exposed to various FRs and plasticizers through their daily household environment. The Canadian adults’ external exposure of hands to FRs and plasticizers were related to the levels in their household electronic products, particularly handheld devices such as cell phones. Handheld devices could contribute to human exposure through direct contact during use while large and stationary electronic products could be important sources and sinks in household environment.

TU355
Modelling diffuse emissions and fate of engineered nanoparticles used in outdoor paints to urban surface waters at high spatial and temporal resolution
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The expansion of the nanotechnology sector is leading to an increased use of products containing engineered nanoparticles (ENPs) in outdoor urban environments. Outdoor materials, such as construction materials, paints and coatings, are subject to weathering and ageing processes and will consequently lead to emissions of ENPs to the surrounding environment over time. Data on measured environmental exposure concentrations are still lacking for ENPs. Until analytical and monitoring techniques for ENPs in environmental matrices become available, modelling tools are the best approach to estimate exposure levels. Furthermore, models can analyze a wide range of potential scenarios and predict possible future trends of urban exposure which cannot be achieved by monitoring. In this study we propose a model (ENVIRON) that combines an emission and a fate model for ENPs with high spatial and temporal resolution for an urban environment. The model was applied to the study of titanium dioxide (TiO2) ENP emissions when incorporated in outdoor paints in the city of York (UK). The model emission calculations are based on locally collected data on outdoor paint usage (outdoor paint application ratios and frequency of application for York) and information about the sewage network connectivity around the city. Reliable and official sources of information, such as Yorkshire Water and York City Council, and surface water characteristics acquired from an extensive and local monitoring campaign performed in the rivers Ouse and Foss, helped to parametrize the river fate model. Using the model, the transport and fate of TiO2 ENPs in the rivers circulating within the city (the Ouse and the Foss) could be studied and spatially resolved results obtained. The identification of hot spots of emissions within the city and the study of ENP transport and fate are accomplished by this approach.

TU356
Occurrence and human exposure of parabens, trioclosan and triclocarban in personal care products from Korea
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Ten parabens (p-hydroxybenzoic acid esters), trioclosan (TCS) and triclocarban (TCC), have been extensively used in various cosmetics and personal care products (CPPCs) as preservatives due to their antimicrobial activities. However, little is known about the occurrence and exposure levels of parabens, TCS and TCC associated with the consumption of CPPCs in our daily life. In this study, ten parabens, TCS and two metabolites, TCS and TCC were measured in 243 CPPCs, which comprised of leave-on products (n=157), rinse-off products (n=59) and baby care products (n=31), collected from Korean market during 2016-2017, using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Among ten parabens, methyl paraben (MeP) showed the highest detection rate (57%), followed by propyl paraben (PP, 49%) and butyl paraben (BuP, 41%). TCS had only 20% of detection rate and TCS was rarely detected in the samples. Total concentration of parabens widely varied with ranging from < LOQ to 10200 µg/g. Concentrations of TCS and TCC ranged from < LOQ to 340 ng/g and < LOQ to 14.0 ng/g, respectively. Higher concentrations of parabens (> 1000 µg/g) were found at skin cares, sunscreen, face cleanser, eyeliners, body/hand lotions and lipstick. The daily exposure levels of parabens and TCS was calculated by the consumption of leave-on products and exposure factors, obtained from questionnaire-based survey and previous studies, and concentrations measured in our study. The mean daily exposure levels of parabens were 16.2 and 0.14 µg/kg body weight/day for mothers and their infants of Korea, respectively. Among CPPCs, some leave-on products such as skin cares, body/hand lotions, and sunscreens were the major contributors (> 80%) to total exposure levels of total parabens.

TU357
Characteristics of exposure factors for consumer products in Korean infant and caregivers pair
K. Lee, Seoul National University, Graduate School of Public Health; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science

Concerns about potential health risks of chemicals in consumer products like cosmetic, personal care products, food containers are growing. Especially infant and children are more vulnerable to chemical exposure compared to adults. Since exposure to these chemicals could be determined by consumer products usage pattern, an accurate measurement of the usage patterns of consumer products is important for realistic exposure assessment. The aims of this study were to determine exposure factors of consumer products for child and mother and analyze the relationship between consumer exposures of caregiver and infant. We determined the exposure factors of 12 kinds of cosmetic (3 basic cosmetics, 1 UV protection products, 3 food products, 3 body products and 2 cleansing products) for adults and 10 kinds of consumer products (2 cosmetics, 3 oral supplies and 7 household products) for children and 11 kinds of food containers for household. Survey was conducted on 505 mother-infant pairs from Oct. to Dec. 2015 in Seoul metropolitan area by a structured questionnaire. The number of subjects were determined by proportioning among baseline population of mother-infant pairs from Oct. to Dec. 2015 in Seoul metropolitan area by a structured questionnaire. A total of 1450 mother-infant pairs from Oct. to Dec. 2015 in Seoul metropolitan area by a structured questionnaire. Data on measured intake by food containers ranged 2.52 to 17.39 times a month. The use of children's oral supplies varies according to the age of the child. There were a significant difference in the mother’s usage rates of lotion, hair products and vinyl package food by age of children. These exposure factor characteristics could be useful input data for exposure risk and assessment for chemical regulation.

TU358
Analysis of metabolites of organophosphate and pyrethroid pesticides in urine from Italian children
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Organophosphate (OP) and pyrethroid (PYR) pesticides are commonly used in agriculture, domestic environments and gardening. They eliminate insects because of their strong potential to disrupt the brain and nervous system of these organisms. Unfortunately, this neurotoxic effect is not selective enough as to avoid potential damage to other non-target species, including humans. OP and PYR pesticide exposure has been related to several human health effects, including respiratory, digestive, productive and neurological problems, among others. Children are more vulnerable than adults to environmental pollutant exposure because their organs and metabolism are still under development. Thus, their detoxification mechanisms are not yet mature. Once in the human body, OP and PYR pesticides are typically metabolized and excreted in urine within 4–48 hours after exposure, depending on the compound. Organophosphates are metabolized into dialkyl phosphates (DAPs) and their O-alkylphosphoryl metabolites. The metabolic products of the most common OP pesticides, such as diethylamino phosphorothioate (DEAMPY, metabolite of pirimiphos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarboxylic acid (MDA, metabolite of malathion), 3-chloro-4-methyl-7-hydroxycoumarin (CMHC, metabolite of coumaphos), 2-isopropyl-6-methyl-4-pirimidyl (IMPY, metabolite of diazinon) and 2-diethylamino-6-methyl pyrimidin-4-ol (DEAMPY, metabolite of pirimiphos). Concerning pyrethroids, most compounds such as permethrin, cypermethrin, deltamethrin, allethrin, resmethrin and fenvalerate are metabolized into one single compound, 3-phenoxbenzoyl acid (3-PBA). On the other hand, cyfluthrin is metabolized into 4-fluoro-3-phenoxbenzoyl acid (4-F-3-PBA). Therefore, 3-PBA and 4-F-3-PBA can be used as a biomarkers of the most common PYR pesticides. The determination of the above mentioned compounds was performed using isotope dilution solid phase extraction coupled to tandem mass spectrometry (UPLC-MS/MS). Human urine samples (n=199) from Italian children at 7 years were analyzed. Neuropsychological and psychomotor development of the children was assessed at 18–40 months by using the BAYLEY scales. In addition, neuropsychological development and intelligence were assessed at 7 years by using the NEPSY-II and the WISC, respectively. The compounds detected the most were DEAMPY (98%), PNP (97%), 3-PBA (91%) and TCPY (87%). The metabolite showing the highest concentration was DEAMPY with a median of 3.0 ng/mL followed by PNP, 3-PBA and TCPY with medians of 1.3, 0.56 and 0.47 ng/mL, respectively.

TU359
PAH levels in parturient and newborns from Aveiro region, Portugal
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Environmental exposure to humans may be critical in some residential and working areas, and therefore biomarkers can and should be used as early warning tools to depict exposure and evaluate effects. Polycyclic aromatic hydrocarbons (PAHs) are a group of priority chemicals to be studied and monitored as they are considered carcinogenic and teratogenic. In the present study we aimed to monitor human fetal exposure to PAHs by measuring concentrations of naphthalene, phenanthrene, pyrene and BaP equivalents in placenta, umbilical cord and mother’s blood (plasma and blood cells) of 49 parturient from Aveiro region, Portugal. Information organized in questionnaire forms, tissues and organs were collected following the
parturient consent. Levels of PAHs equivalents were measured by a fluorescence methodology and were correlated with exposure to tobacco smoke as well as with other information regarding mother’s lifestyle (e.g. urban or rural residential area, exposure to vehicles exhaust). In general, the studied group presented higher PAHs levels in the placenta and lower PAHs levels in the umbilical cord blood. The low molecular weight PAHs (naphthalene and phenanthrene) measured in placenta presented higher correlation than high molecular weight PAHs (pyrene and benzo[a]pyrene). Moreover, increased levels of pyrene and phenanthrene equivalents were associated with exposure to vehicle exhaust, while higher levels of benzo[a]pyrene were associated with exposure to tobacco smoke at work. The highest naphthalene, pyrene and BaP equivalents levels were found in homogeneous placenta of mothers who smoked in the third trimester of pregnancy. No significant correlation were found between PAHs levels and anthropometric data of newborns, but in general, higher PAHs levels were found in newborns groups with lower weight, head circumference, and length. Maternal-infant biomonitoring can be a major asset in evaluating environmental exposure to contaminants, which can also provide high value information for preventive medicine.

TU360 A modelling framework to link aggregate exposure pathways with internal exposures and potential bioactivity J.A. Arnott, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; J. chesta, in used in ARC Arnot Research & Consulting; L. Li, University of Toronto at Scarborough / Department of Environmental Sciences; X. Zhang, University of Toronto Scarborough / School of Engineering and Applied Sciences; B. Givechhi, J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences

The aggregate exposure pathway (AEP) model is a conceptual framework to help align available exposure information including (i) production, use and release, (ii) chemical fate and concentrations in various multimedia (urban and rural environments, biota), (iii) external exposures (e.g., contact rates), and (iv) internal exposures (e.g., blood concentrations) for human and ecological receptors. Some exposure models include elements of the AEP framework and are useful tools for organizing data, quantifying chemical concentrations throughout the source-to-exposure continuum and identifying research needs to address uncertainty in chemical evaluations. We present an overview of the Risk Assessment Identification And Ranking-Indoor and Consumer Exposure (RAIDAR-ICE) modelling framework. RAIDAR-ICE includes direct and indirect indoor exposures and can include far-field exposures for aggregate human exposure assessment. The RAIDAR-ICE model is parameterized in this case study for about 200 organic chemicals comprising a broad range of chemical properties representative of commercial chemicals to demonstrate model applications for exposure and risk-based prioritization. Based on assumed emissions to air in the indoor environment, intake fractions (used for ranking exposure potential) range from 0.0018 to 0.37 emphasising the relatively high potential for human exposure to PAHs due to indoor and indoor residential exposure sources. Following the same exposure scenario, unit emission rate based whole body concentrations (exposure potential) range from 3×10⁻¹⁰ to 5×10⁻⁹ mmol/kg. The differences in ranking chemicals for exposure based on either external (intake fraction) or internal (concentration) exposure metrics are substantial due to chemical-specific differences in toxicokinetics. In absence of well-defined chemical use information, the model calculated critical emission rates can be used to gauge potential risks and provide guidance for proposed new chemical use. Using in vitro bioactivity data from the ToxCast program as an assumed “effect threshold”, the critical emission rates of the case study chemicals span approximately 8 orders of magnitude. Including estimates of actual chemical use rates allows for the calculation of risk (bioactivity)-based estimates; the results of which span 10 orders of magnitude. Recommendations for addressing uncertainty in the model and its required input parameters are presented.

TU361 ENVIRONMENTAL IMPACT OF LEAD MINING ON THE BIO-ECOSYSTEM IN ISHIAGU TOWN OF EBNONY STATE IN SOUTH-EASTERN NIGERIA S. Anika, UNIVERSITY OF NIGERIA, NSUKKA; V. Ahur, Federal University of Agriculture Makurdi / Department of Veterinary Physiology, Pharmacology and Biochemistry; P. Onyeyihi, Federal University of Agriculture Makurdi / Department of Physiology Pharmacology and Biochemistry

Lead is a soft, dense metal found naturally in the environment and accounting for 0.0016% of the earth’s crust. However, due to its ubiquitous nature, it is used in several industrial processes which can result to severe environmental pollution which can pass across food chains to animals and man. In 2010, about 400 deaths especially among children in Bukkuyum and Anka LGA of Zamfara State, Nigeria, due to chronic lead toxicity were reported by Medecins Sans Frontieres (MSF, Holland) to the health authorities (UNEPOCHA 2010). The cause of the high mortality was acute and chronic lead poisoning as a result of massive environmental contamination from artisanal mining and processing of gold in Pb-rich ore by poor headsmen and farmers. This outbreak was reported as the worst in modern history (UNEPOCHA 2010). Open-pit mining of lead in the Ishiagu Region of Ebonyi State since 1965 has exposed large volumes of marcasites, pyrites and tailings contaminating the environment and food chain pathways. The research was designed to investigate the environmental impact of lead mining on the bio-ecosystem of Ishiagu town and environs. Soil, water, grasses/plants, food, fish and quarry dust were collected between March and May 2017, processed and analyzed for lead concentrations. All water samples exceeded WHO recommended safety limits for lead. Soil and food samples contained values. Sampling of Ivo River, the main communal water source showed links to upstream pollution as the river passes through lead mining fields. The result showed the negative impact of lead mining in Ishiagu and the need for regulatory agencies/government to take measures to avert consequences of lead poisoning in human beings.

TU362 Evaluation of potential risk of rare earth element contamination from leachate originating from electronic waste disposal M. Makome, Scientific Services, Cape Town / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. Scarisbrick, CTP / University of Salford

Rare Earth Elements (REEs) form critical elements required in technological accessories. Their presence in electronic waste gives leads to environmental pollution. Therefore, there is a constant necessity for accurate data and reliable fast analytical methods. This review discusses and compares the methods given for the determination of rare earth elements and heavy metals in electronic waste and other associated depositories and its decontamination in urban environments. In fact, acid dissolution and alkaline fusion are commonly employed. Various instrumental techniques that have been used recently includes electrothermal vaporiser or laser ablation accessory connected to ICP-MS or ICP-OES, X-ray Fluorescence and electro-analytical techniques. These methods of analysis including their accuracy, limit of detection (LOD) and limit of quantification (LOQ) are compared and discussed. This study further emphasizes the importance of bioavailability, risk assessment methods and instrumental techniques with a focus on rare earth elements in electronic waste and its disposal into the environment. Key words: Rare earth elements; electronic waste; fusion optimisation; spectroscopy; wastewater

TU363 A stonework snail as a new biomonitor of metal contamination in the urban environment E. Rota, B. Braccino, R. Dei, University of Siena / Department of Physical Sciences, Earth and Environment; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Anika, University of Siena / Department of Geology, Earth and Environment; R. Bargagli, University of Siena / Department of Physical Sciences, Earth and Environment

Papillifera papillaris (O.F. Müller) is a small pulmonate gastropod commonly dwelling on stone walls and monuments in Italian and Mediterranean urban environments. This widespread, low-vagile and omnivorous organism, which barely interacts directly with soil and inhales fine particles, is a promising indicator of urban and indoor urban pollution and makes a good bioindicator to emission sources. The chemical composition of the shells, soft tissues and faeces of snails collected from vegetated walls, at roadside and common garden habitats is compared (Classical and elemental methods). The soft tissues of P. papillaris (purged of the gut contents) showed the highest Cd, Cu and Zn concentrations at the most trafficked sites. Data from faeces suggested that this species ingests large amounts of inorganic particles scraped from the stone surfaces, as indicated by the very high Al, Cr, Fe, Mn, and Pb concentrations. Most lithophilic elements and Pb are scarcely absorbed in the snail digestive tract and soft tissues mainly accumulate Cd and essential elements such as Cu, Zn and Mn. Although the chemical composition of the shells was characterized by low concentrations of all analyzed elements, the samples collected at the most trafficked sites had significantly higher Cu, Fe, and Zn concentrations. This bioaccumulation in P. papillaris shells likely remains after death, potentially providing a historical record of the snail exposure to metals over lifetime.

TU364 Metals Distribution in Urban Garden Soils in Greater Victoria, BC, Canada M. Dodi, Royal Roads University / School of Environment & Sustainability

This study was conducted to determine heavy metal distribution in surface soils in Greater Victoria and surrounding areas, British Columbia, Canada. Over 200 soil samples were collected from 190 residential and community gardens and analyzed using a portable XRF. A subset of the samples were analyzed by ICP-MS. A comparison of the XRF metal concentrations to the ICP-MS data indicated that the XRF was a suitable technique for the rapid analysis of the large number of samples collected. Elevated concentrations of metals including Pb, Cu, Cr and Zn, were found in some garden soils. Based on homeowner interviews, historical maps and archival reviews, Pb contamination was primarily attributed to the use of leaded paints and housing maintenance practices. Potential sources of the other metal contaminants included the use of wood preservatives, septic fields, automatic
repair and old orchards. An interactive map of metal distribution based on the data obtained was developed and made available to the public. Metal bioavailability was assessed using an in vitro bioaccessibility assay and the data used to assess the risk associated with soil ingestion. The estimated daily intake was determined for each element incorporating metal bioaccessibility data. Using the median concentrations, the calculated EDI values were well below the respective tolerable daily intake suggesting that the risk associated with ingestion of metal contaminants was minimal. Dandelion samples were also collected and analysed as surrogate plants to determine potential metal uptake. Metal bioaccumulation factors and translocation factors for the dandelion samples also suggested that the potential for the uptake of the metals studied was low. However there were isolated gardens with elevated Pb concentrations which were identified as being of concern. Recommendations for limiting Pb exposure in these gardens were provided to the home owners.

TU365 Soil quality analysis, a lever for identifying sources of trace elements and managing urban allotments for urban agriculture production
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Projects seeking to produce home-consumption vegetables in urban areas and, more generally, to set up agricultural production inside cities, are increasingly numerous. Agglomeration and local public authorities also need references on thresholds of contamination in trace element and their transfer into plants. At European level, soil quality regulations are not homogenous; in France, the legislation is mainly based on the contents in vegetables or fruits, the link with the soil never made. Some studies have highlighted the potential risk of metal contamination of vegetables grown in urban areas and the lack of site-specific risk assessments. However, experimental trials are still lacking on the potential of using urban soil as a good substrate for producing vegetables for domestic consumption. We assessed the quality of the soil on a site in the Rouen agglomeration (Nord-France, France) for three purposes: pasture, a food production zone and market gardening area. However, the city raises questions about the future management of this last area already cultivated for many years. We have analyzed the main physiochemical characteristics of soils, the trace elements (Pb, Cu, Ni, Zn, Cd, Hg) in certain vegetables and fruits and in soils, as well as the history of agricultural practices since the sixties and the topography of the site. Transfer coefficients in consumption vegetables have also been quantified. Our results showed that the zones had a physical and chemical heterogeneity due to the effects of the different cultivation techniques used, the urbanization and the topography of the site. Some metals contents are often above the recommended limits, and soil conditions (pH = 8) significantly reduce the mobility of metals. The concentration of Pb in some of the cultivated urban samples is above limits, which makes gardening practices unsuitable for the area. Our results demonstrate that site-specific studies are needed before planning urban cropping areas, and educating urban gardeners about sustainable cropping techniques is a priority for safe feeding.

TU366 Vertical movement of PCBs in agricultural soils impacted by an historical contaminated site: using SoilPlus model to predict discharge, dynamics of movement in soil, and rhizoremediation potential
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Among the national priority polluted sites, the SIN Brescia Caffaro is located in a mid size city Brescia, (200,000 inhabitants) in northern Italy. The site derived from the activity of the former Caffaro s.p.a., a chemical factory among the largest in national importance in Brescia. The site has been an agricultural area since the sixties and the topography of the site. Some metals contents are often above the recommended limits, and soil conditions (pH = 8) significantly reduce the mobility of metals. The concentration of Pb in some of the cultivated urban samples is above limits, which makes gardening practices unsuitable for the area. Our results demonstrate that site-specific studies are needed before planning urban cropping areas, and educating urban gardeners about sustainable cropping techniques is a priority for safe feeding.

TU367 Metals and metalloids in inhalable fractions of urban road dust
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Road dust is highly enriched with metal and metalloids such as Cu, Zn and Cd, due to road surface attrition and wear of automotive components. Despite the importance of road dust as a source of inhalable particles (< 10 µm), little has been published regarding elemental enrichment patterns in particle sizes relevant to inhalation exposures. The goal of this study is to evaluate the contribution of road dust to airborne particulate matter, focussing on metals and metalloids in the inhalable particle size range. Road dust samples were collected from a variety of street types in 2015-2016 in collaboration with the City of Toronto, representing a total road length of about 840 km. Two types of samples were generated by the regenerative-air sweepers: the bulk hopper debri and finer dust box samples. The 50th percentile particle size diameter of the dust box samples was determined by laser analysis to be 9.4 µm, which represents the inhalable fraction. A total of 64 samples (32 inhalable and 32 bulk samples) were subjected to a 4-acid digestion (HF, HClO4, HNO3 and HCl) followed by multi-element determination using Inductively-Coupled Plasma Mass Spectrometry (ICP-MS). Results showed that the inhalable fractions of road dust were enriched with metals and metalloids relative to the bulk debris, including Cd (0.55 vs. 0.25 µg/g), Zn (6.69 vs. 252 µg/g), Pb (8 vs. 2.2 µg/g) and Zn (80 vs. 54 µg/g). The enrichment of elements of known toxicology in the inhalable fraction is of particular concern, given the bioaccessibility of this particle size range. Available data on the total weight of road dust collected by the City of Toronto each year, combined with the elemental concentrations of the road dust determined in the present study, provides the means to calculate annual flux estimates. For example, Pb loadings in the inhalable fraction alone are estimated to range between 70 kg/yr and 141 kg/yr, which is a significant source relative to the city’s total Pb emissions reported by industries and municipal facilities in the National Pollutant Release Inventory. This example demonstrates the importance of non-exhaust forms of traffic emissions which have not been included in emission inventories to date. Next steps will involve the collection of whole, unfractinated road dust samples from a variety of road types for particle size distribution analyses to refine elemental loadings in each size fraction.

TU368 Sequential extraction and particle size distribution of Cd, Cu, Pb and Zn in street dust of Belgrade (Serbia)
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The aim of this study was to investigate the differences in distribution of Cd, Cu, Pb and Zn in mobile phases extracted from different size-fractions in street dust particles from Belgrade, the Capital of Serbia. The metals investigated were chosen as the most significant pollutants according the European Environment Agency. The street dust samples were collected in summer 2016 at three different locations. The samples were fractioned into three sizes with diameters of: < 63 µm, 63 – 250 µm, and 250 – 500 µm. From different size fractions the metals were isolated into three fractions using a modified sequential extraction procedure after Tessier (Tessier et al., 1979). adsorptive and ion-exchangeable phase (using ammonium acetate); moderately reducible phase (using ammonium oxalate and oxalic acid); and organic sulphide phase (using hydroxy peroxide acidified with nitric acid). These fractions were analysed by inductively coupled plasma optical emission spectrometry (ICP-OES) using an ICP iCap6500 Duo-Thermo Scientific instrument. The results showed that the concentrations of the metals (based on the sum of these three fractions) were in the following order: Zn > Cu > Pb > Cd. Comparison with the Serbian national Regulations demonstrated that the concentrations of Cu and Zn in these three fractions were higher than the Maximum allowed values at some locations only, indicating serious contamination with these metals at some locations. The phase partitioning study revealed that Zn and Cu were bound mainly in the second phase. Pb and Cd were predominantly associated with the first phase. Cu in one sample predominantly associated with the third phase while Cd was in one sample predominantly associated with the first phase. Detailed analysis of distribution of metals in different size fractions did not indicate any patterns suggesting a different origin of these metals at different locations. Regulations: About allowed quantities of dangerous and harmful materials in soil and irrigating waters and methods about their analysis. Government Gazette of the Republic of Serbia No. 229/01 (Serbian) Sequential (4 step) extraction procedure for the speciation of particulate trace metals. A. Tessier, P. G. C. Campbell, and M. Bisson. Analytical Chemistry, 1979, 51 (7), pp 844 – 851

TU369 New "OPEs": isopropylated, tert-butylated and di-tert-butylated Triarylphosphate Isomers in E-waste, House, Car and NIST SRM Dust
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Organophosphate esters (OPEs) have been measured at relatively high concentrations globally in remote to urban locations with highest levels in indoor environments. Studies of OPEs often comment that these are “new” compounds, citing their use as replacements of some now restricted brominated flame retardant. Here, “even newer” organophosphate esters were investigated in this study of dust samples from several locations with varying site types. The sample locations and types tested here include dust from Canada (houses from Vancouver and Toronto), Turkey (homes and offices from Istanbul), and Egypt (homes, offices and cars from Cairo), dust from an e-waste facility in Toronto, Canada, and NIST house dust (SRM 2583-2585 from American homes). The new OPEs detected in these samples were brominated triaryls phosphates (ITP) and tert-butyl triaryls phosphates (TBTP) and a di-tert-butylated triaryls phosphate and di-tert-butylin triaryls phosphite. These compounds are used as flame retardants, but are also used in hydraulic fluids and as plasticizers. ITP is primarily used in foam and is a component of Firemaster 550 whereas TBTP is in Firemaster 600. Preliminary results indicate ITPs and TBTP levels are found in the ng/g range in these dust samples. OPEs are known to be “new” compounds, whereas the typically analyzed OPEs compounds such as tris(2-butoxyethyl)phosphate (TBP), triis(2-chloroethyl)phosphate (TCEP) and tris(chloropropyl)phosphate (TCP) are also known. Even though these are new to us and only recently included on some national regulation lists, these compounds are found in NIST SM dusts that were collected in the mid-1990s thus have been high production volume chemicals for many decades. These compounds are of concern because they have long range transport potential as one ITTP isomer was sought and found in arctic water and sediment. A few studies have shown that humans are exposed ITPs due to detection in wristbands and metabolites in urine. These compounds are also of concern due to their reported toxicity especially related to neurological effects.  

TU370

OXIDATIVE POTENTIAL OF PARTICULATE MATTER COLLECTED AT INDUSTRIAL AND URBAN SITES

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The scientific world is still questioning about the effects of airborne particulate matter (PM) concentration and composition on human health, and different scientific approaches have been evaluated in order to gain information about it. The measurement of its oxidative potential (OP) is generally considered as a predictive index of PM ability to generate reactive oxygen species (ROS) in biological organisms, and different acellular assays are currently used in literature for its determination. In this work we applied three of the most used OP assays (dithiothreitol - DTT, acid ascorbic – AA, and 2,7-dichlorofluorescin –DCFH; Fang et al., 2016, Huang et al., 2016) to PM2.5/PM10 samples and to size-segregated dust samples collected by a 10-stage impactor. Samplings were performed at an industrial site near Ferrara (Po Valley; Italy) and at a traffic urban site in Rome (Italy). All the samples were also analysed for anion, cations, macro- and micro-elements, total organic content, elemental carbon and water-soluble organic carbon, in order to identify the relationships between OP values and PM chemical composition and dimension. Despite the very different composition of PM in the two monitored areas, OP values were scarcely dependent on the sampling site: species whose concentration is very different in the two areas, such as secondary inorganic anions, seem thus to play a negligible role in the ROS generation. Each assay showed a different sensitivity towards the oxidant species: the DTT method was more sensitive to organic substances, while the AA method was more sensitive to the inorganic compounds. This period in microcosms, in which the DTT assay led to a greater affinity with particles in the fine mode, while AA responded mainly to particles in the coarse fraction. DCFH results appear to be driven by a competition between several factors, some increasing the response and some suppressing it. Fang, T. et al.: Oxidative Potential of Ambient Water-Soluble PM2.5 in the Southeastern United States: Contrasts in Sources and Health Associations between Acidic Acid (AA) and Dithiothreitol (DTT) Assays. Atmos. Chem. Phys. 2016, 16, 3865-79. 10.5194/acp-16-3865-2016 Huang, W. et al: Optimization of the Measurement of Particle-Bound Reactive Oxygen Species with 2,7'-dichlorofluorescin (DCFH), Water Air Soil Pollut. 2016, 227, 164.

TU371

Chromatographic determination of the pathway of nevirapine in wastewater at a wastewater treatment plant

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Emerging pollutants (EPs) are defined as substances that have been detected, which is not included in the routine monitoring programmes at the EU level, and whose fate, behaviour and ecotoxicity effects are not well understood. Pharmaceuticals used in the treatment of HIV, known as anti-retrovirals, are becoming prevalent and there is a need to quantify these and minimise any adverse effects to aquatic and human health. Nevirapine (NVP) is commonly used in the anti-retroviral treatment of HIV infection. It is known as a non-nucleoside reverse transcriptase inhibitor of the dipryridazepine class, commonly used to minimize viral resistance. This study reports the isolation and chromatographic characterisation of NVP in wastewater samples, with concentrations ranging between 250 to 500 ng/L. Further evaluation of the impact of NVP on the aquatic ecosystem was also considered and reported in this study. Keywords: Anti-retrovirals; Emerging pollutants; Chromatography; Wastewater

TU372

Luminol blue: a selective photometric reagent for chlorine dioxide analysis in water

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Drinking water supply companies have traditionally focused their efforts on providing a product with health guarantees, a safe and clean water. Disinfection has been the main purpose of the water treatment. A broad range of disinfectants and technologies are available. Chlorine dioxide has been increasingly used because of its ability to avoid the formation of trihalomethans (THMs), the most common and well-known disinfection by-products. NN-Diethyl-pphenylenediamine (DPD) method has been without any doubt the most common procedure for the analysis of free and combined chlorine (chloramines) and also, chlorine dioxide. While this method easily permits the differentiation between free and combined chlorine, the selectivity of the analysis of chlorine dioxide when chlorine is present has recently been questioned. As a result, this procedure has been removed from Standard Methods (American Water Works Association) and qualified as “reserved” method. Given this circumstance and the need of having a selective method for chlorine dioxide disinfection, several UV-VIS and spectrophotometric methods have been evaluated by our group (1). Here, the results using luminol blue are presented. This chromophore agent is obtained by reduction of methylene blue and its use for the analysis of chlorine dioxide is scarcely described in the literature. Our experiments show that it presents a good analytical performance, and what is more important, measurements are not interfered by elemental chlorine. The method showed a good accuracy with real water samples (relative error below 14 % for chlorine dioxide concentrations between 0 and 1.5 mg/L). This reagent has revealed to be the best option among the different compounds that we have used – amaranth, lissamine green, and chloro phenol methyl red-. The only drawback of the procedure is the interference by high concentrations of sulphate. Ongoing work is taking place to avoid it by previous precipitation of the interferent or liquid extraction of the dye. This method has been developed. (1) P. López et al. Chemical and sensory analysis of chlorine dioxide in drinking water. Part II. SETAC Europe 26th Annual Meeting. May 2016. Nantes (France).

TU373

Fate and effects of triclosan in subtropical freshwater hethic microcosms

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Triclosan (TCS) is one of the top 10 most commonly detected organic pollutants in the aquatic environment. However, little is known about the toxicity and bioaccumulation of sediment-associated TCS. We examined the effect of sediment-associated TCS on the snail, Viviparidae Bellamy, and the worm, Limnodrilus hoffmeisteri, and assessed worm bioaccumulation during a 28 days experiment with an organically polluted system. The results showed that TCS was detected in worm tissue with biota sediment accumulation factor (BSAF) values ranging between 0.67-6.3, suggesting that TCS could be accumulated in worms. The results of mass balance assessment showed that, during the experiment period, TCS amount in the microcosm was reduced 3.4% to 11.4% and 3.5% to 10.9% in the systems with and without macroinvertebrates, respectively. Based on the experimental conditions used, we conclude that sediment-associated TCS (8 μg/g dry weight (dw)) is unlikely to affect, at least in the short term, survival and growth of snails and worms in sediments, with no observed effect concentrations (NOECs) of 8 μg/g dw for both
Environmental Safety

Protection goals for the ecological risk assessment of chemicals are increasingly being framed in terms of ecosystem service delivery [1]. However, the type of data collected to assess risk is generally at the level of individual organisms or simplified multi-species systems. Currently, extrapolation from what is measured to what we want to protect uses overly simplistic approaches, such as risk quotients or toxicity-exposure ratios. Ecological models provide a more mechanistic way of considering these disparate levels and allow for integration of other relevant information as well as feedbacks across levels of organization [2]. Here we present output from the National Institute of Mathematical and Biological Synthesis (NIMBioS) working group (www.nimbios.org/workinggroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification of the mechanistic impacts of the effects of chemicals and other stressors on ecosystem services delivered by a lake ecosystem, modified to represent a reservoir in Iowa, USA. The first case study is an example where managing for provision of the service GCT population provides will differ depending on the level of EE2 in the system. If EE2 concentrations are low, then management would need to focus on controlling BT populations. For high concentrations of EE2, management first needs to focus on reducing EE2, followed by control of BT. The second case study is an example where game fish species responded differently to exposure to the insecticide, as a result of interspecific interactions, and the economic valuation of this service needs to take into account with angler preferences. The service of water clarity for recreational activities was valued using threshold-based estimations of days fit for recreation. We provided concrete examples of how ecological modeling can be used to quantify impacts on ecosystem services from data gathered in standard testing. We discuss challenges and ways forward.

TU375 French Phytopharmacovigilance: a national scheme for monitoring the adverse effects of plant protection products

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Phytopharmacovigilance is the latest complement to ANSES’s existing missions concerning the assessment of the risks associated with plant protection products before marketing, and the issuing and withdrawal of marketing authorizations. It is also fully in line with the third component of the Ecophyto plan. This national plan, established for the first time in 2008, was recently renewed. It aims to reduce pesticide uses in accordance with the requirements of Directive 2009/128, establishing a framework for Community action to achieve the sustainable use of pesticides. A specific scheme for funding these studies is planned through a tax on sales of plant protection products payable by the marketing authorisation holders. To meet this objective, phytopharmacovigilance relies on three fundamental and complementary methods of data collection and knowledge production: a network of surveillance or vigilance bodies, collection of spontaneous reports and ad hoc studies on the adverse effects of plant protection products. These studies are financed by PVV to cover three different needs: 1) when the information provided by the surveillance and vigilance bodies is seen to warrant clarification, 2) to investigate spontaneous reports or 3) to collect new data / information. To identify the adverse effects of plant protection products on biodiversity and ecosystems, Phytopharmacovigilance is based on the systematic and regular collection of information produced by the existing surveillance and vigilance bodies, covering risks and impacts on wildlife, crops, fauna, flora, air, water, and soil. In the full article (2 pages word/pdf), a detailed list of studies and network working on “Pesticides impacts on biodiversity” and “Monitoring of pesticides (water, air, etc.)” is described.

TU376 Measuring and Modelling Aluminium Bioavailability and Toxicity to Aquatic Organisms

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The ability to accurately predict the aquatic toxicity of aluminium (Al) in natural surface waters has eluded scientists for the past several decades. In 1988, the US Environmental Protection Agency (USEPA) released nationally-recommended ambient water quality criteria for Al of 750 and 87 µg/L as acute and chronic levels, respectively. However, these applied only to waters with a pH between 6.5 and 9, and the chronic toxicity database was limited. Therefore, in 2009 we assembled a team of scientists to help expand this database and identify a means for measuring and predicting the toxicity of Al to aquatic organisms as a function of water chemistry. A series of chronic toxicity tests were performed, as part of this effort, with several freshwater species. The species were selected to meet requirements for the EU REACH dossier, USEPA water quality criteria or European Water Framework guidelines for environmental quality standards. To develop bioavailability models, multiple tests with a green alga (Pseudokirchneriella subcapitata), a cladoceran (Ceriodaphnia dubia), and a fish (Pimephales promelas) were performed across a range of DOC, hardness and pH conditions. These latter data were included in the development of a biotic ligand model (BLM) for the prediction of toxicity as a function of water chemistry. The toxicity data sets were also used to develop a multi-linear regression (MLR) model to provide a simplified means to predict toxicity as a function of DOC, hardness, and pH. Due to its complex environmental chemistry, measurement of the “toxic” form of Al in natural waters cannot be performed using the conventional “total” or “dissolved” analytical approaches. Studies have recently been completed which allows for the measurement of “bioavailable” Al in natural waters where suspended solids are present and contribute to measurements of total Al, but are non-toxic. The presentation will focus on modeling Al toxicity and measuring Al in natural waters.

TU377 Modelling impacts of chemicals on ecosystem services

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Protection goals for the ecological risk assessment of chemicals are increasingly being framed in terms of ecosystem service delivery [1]. However, the type of data collected to assess risk is generally at the level of individual organisms or simplified multi-species systems. Currently, extrapolation from what is measured to what we want to protect uses overly simplistic approaches, such as risk quotients or toxicity-exposure ratios. Ecological models provide a more mechanistic way of considering these disparate levels and allow for integration of other relevant information as well as feedbacks across levels of organization [2]. Here we present output from the National Institute of Mathematical and Biological Synthesis (NIMBioS) working group (www.nimbios.org/workinggroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification of the mechanistic impacts of the effects of chemicals and other stressors on impacts on individual organisms to the delivery of ecosystem services [3]. The first case study applies an individual-based model (IBM) [4] to quantify impacts of potential endocrine disrupting chemicals on services provided by trout populations in a mountain stream in Colorado, USA. The second case study uses an aquatic ecosystem model [5] to evaluate impacts of an insecticide on multiple ecosystem services delivered by a lake ecosystem, modified to represent a reservoir in Iowa, USA. The first case study is an example where managing for provision of the service GCT population provides will differ depending on the level of EE2 in the system. If EE2 concentrations are low, then management would need to focus on controlling BT populations. For high concentrations of EE2, management first needs to focus on reducing EE2, followed by control of BT. The second case study is an example where game fish species responded differently to exposure to the insecticide, as a result of interspecific interactions, and the economic valuation of this service needs to take into account with angler preferences. The service of water clarity for recreational activities was valued using threshold-based estimations of days fit for recreation. We provided concrete examples of how ecological modeling can be used to quantify impacts on ecosystem services from data gathered in standard testing. We discuss challenges and ways forward.

TU378 Sulphur: conflicting protection goals

G. Brouwer, Delphy / team fruitteelt; F.M. Bakker, Eurofins-Mitos

Sulphur is a key fungicide biologically active ingredient. Following a recent risk assessment, the use of sulphur in The Netherlands has been rigorously limited. Current regulations allow for two applications, which is incompatible with disease control in biological top crop production. The regulatory decision was technically correct and based on considerations for non-target arthropods, as risk for the egg parasitoid Trichogramma could not be excluded. Under current European regulations Trichogramma is one of the sensitive indicator species selected for higher tier testing. As this is a natural enemy of several Lepidopteran pest species, the indicator is clearly linked to the specific protection goal of preserving natural pest control potential. However, in the absence of alternatives, at a broader level this specific objective frustrates the current system of biological production as a whole. The specific protection goal must clearly be balanced against the broader objectives of preserving biological production. To understand the importance of egg parasitoids such as Trichogramma in Dutch orchards, the Dutch Fruit Growers Organisation have investigated the control potential of egg parasitoids in 8 orchards (4 biological, 2 conventional and 2 untreated), using parasitization rate as a functional endpoint. The investigations show that parasitization rates are extremely low (< 1% of bait cards and < 0.005% of the host eggs showed parasitization), suggesting a minor role of biological control and other parasitoids in these systems in The Netherlands, at least at the time of the study (late summer 2017). Conventional orchards showed no parasitization and regular (i.e. having sulphur treatments) and untreated orchards did not show differences. These results show that specific protection goals may have country specific weight and need to be considered and balanced against potential negative impacts of eventual protective measures, such as in this case jeopardizing biological top fruit production.

The Need for Resilience in Environmental Impact Assessment (P)

TU379 Recovery in environmental risk assessments at the European Food Safety Authority (EFSA)

T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; F. Bigler, Retired; G. Frampton, University of Southampton; C. Hogstrand, Kings College London / Division of Diabetes and Nutritional Sciences; R. Luitink, Retired; F. Martin-Laurent, INRA Dijon; C.J. Topping, Aarhus University / Department of Bioscience; W. Van der Werf, Wageningen University; A. Rortais, European Food Safety Authority

The European Food Safety Authority (EFSA) performs environmental risk assessments for single potential stressors such as plant protection products, genetically modified organisms and feed additives and for invasive alien species that are harmful for plant health. In 2015-2016 a Working Group of the Scientific Committee of EFSA (the authors of this abstract) explored how ecological recovery is covered under current single-stressor Environmental Risk Assessment (ERA)
schemes at EFSA and how recovery could be assessed considering the complexity of the environment. An important aim of these activities was to promote a dialogue between different panels of EFSA and risk assessors and risk managers responsible for the food and feed chains. Another important aim was to provide risk assessors with a conceptual framework to address ecological recovery in ERAs for any assessed products, and invasive alien species that are harmful for plant health. This framework proposes an integrative approach based on well-defined specific principles and a guideline for the conduct and output of environmental impact assessments. The framework includes an integrative risk assessment approach for reviewing and selecting the selection of mitigation measures (See the draft version of the framework). The framework highlights the following important conclusions and recommendations: it addresses ecological recovery in ERA for potential stressors that fall under the remit of EFSA and its Scientific Committee (2016). Recovery in environmental risk assessments at EFSA. EFSA Journal 2:016; 14(2):4313. 85 pp

TU380 Habitat Equivalency Analysis for a Restoration Resilience Model of the River Doce Basin
P.N. Booth, Ramboll Environ / Ecological Sciences; E. Singer, F. Gomes, R. Arantes, Ramboll Environ / Sao Paulo; R. Wenning, Ramboll Environ
A Resilience Model was prepared to support environmental, economic, and social restoration of the River Doce Basin after the Fundão Dam failure in Mariana, Minas Gerais State, Brazil. A Habitat Equivalency Analysis (HEA) was applied to quantify lost ecosystem services resulting from the disaster and was intended as a means to guide the establishment of the habitat restoration (VECs) being refined through a process of stakeholder engagement to determine the relative value to the environment of the components and types of habitats on and around a site. It includes consideration of key factors affecting recovery and the fate and effects of SEVESO III chemicals, such as PBT substances with high potential for long-term impacts/delayed recovery. An assessor determines that risks are intolerable, then the regulator requires facilities to consider appropriate investment in order that risks are as low as reasonably practicable. Ramboll Environ has pioneered a methodology based on ecosystem services concepts to evaluate the costs and benefits of potential risk management options. The method is used to evaluate the risk in terms of potential ‘damage avoided’ by putting risks into a socio-economic context. Case study examples will be provided of a range of infrastructure upgrade options at fuel storage depots are compared. Environmental Cost Benefit Analysis is used to determine if the upgrade would be grossly disproportionate to the benefit that it would provide in terms of opportunity costs. The analysis incorporates site-specific baseline ecology, other receptors and ecosystem services provided to society. The poster will also reflect upon lessons learned by both regulators and industry in the method development. References: Energy Institute

TU382 Addressing Resilience in Ecosystem Services Assessment
K. Mognariri, Ramboll E&H / Ecological Services; R. Wenning, Ramboll Environ / Ecology & Sediment Management; E. Bizzotto, H.R. Diogo, Ramboll / Ecological Services
An ecosystem services approach to landscape and nature restoration planning and damage assessment should fully account for all aspects of the environment and the human well-being derived from protection, enhancement and repair to natural resources caused by natural and human-caused events. With respect to landscape restoration assessment, conceiving of a resource as a part of an ecosystem that supplies valuable goods and services to people provides a basis for measuring changes and for valuation of those goods and services. With respect to landscape and nature restoration planning, an ecosystem services approach can lead to innovative ideas for ecological infrastructure in cities and promote ecological rehabilitation that may be ecologically and socially desirable and also economically advantageous. Resilience, however, is a key consideration that, to date, has been inadequately considered in ecosystem services assessment work. Considerations of resilience are especially important in ecosystems, because increasing resilience can reduce the risk that highly valued goods and services will cross critical thresholds and irreversibly degrade or change. Resilience also plays an important role in managing conditions for which it is not feasible, or perhaps not feasible, to develop and implement a rational and cost-effective strategy to manage their regulatory obligations and financial liabilities. A customised probabilistic risk model was developed to facilitate the management of environmental and reputational risks at a portfolio of over 500 industrial sites in Spain. The sites are equipped with industrial equipment that contains large amount of oils. The equipment differs significantly in age, size, design and make, and is equipped with non-standardised spill containment systems. The sites are distributed throughout the Spanish mainland and in the Balearic and Canaries islands, and their environmental and social settings show a large variability. Site investigations were known to have been performed at only 5% of the sites. Initially an Environmental Risk Assessment Model was developed using technical, regulatory, social and environmental data. The compiled and consolidated data were entered into a calculation model developed in Microsoft Office ExcelTM. Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. OracleB’s Crystal BallTM add-on to Excel was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as risk scenario triggers for specific events at specific sites, such as: the likelihood of historic contamination being detected; a new contamination event being generated either on-site or off-site; a subsoil investigation being triggered; soil remediation being required; active or passive groundwater remediation being required; and implementation of a groundwater monitoring programme being required. Probabilistic inputs were also applied to the various cost scenarios that might be triggered. The model generated an environmental risk ranking expressed in purely financial terms. Ten high risk and 23 moderately-high risk sites were identified and an environmental action plan focusing on these highest priority sites was prepared. This allowed the portfolio owner to direct financial and human resources required for site investigation, remediation and preventive maintenance to those sites which could give rise to the highest financial and reputational liabilities.

TU384 Quality stakeholder involvement for resilience in environmental risk
This study measures the indoor particulate matter (PM$_{2.5}$) concentration and the equilibrium equivalent radon (E埃尔 EQUIVALENT) concentration in two university buildings with different ventilation systems. A low volume sampler using Teflon filter paper was used to collect the PM$_{2.5}$ samples and inductively coupled plasma mass spectrometry was used to determine the concentration of heavy metals. The concentration of indoor radon was measured using a radon detector model DOSEman PRO. The potential human health damage due to the inhalation of carcinogenic and non-carcinogenic trace elements was also determined based on the US EPA standard. The equilibrium factor and the annual effective dose on the lung cancer risks of each occupant were calculated and a correlation of the radon concentration was made with the annual inhalation dose of the occupants at the indoor stations. The results showed PM$_{2.5}$ concentrations recorded in Building 1 and Building 2 ranged between 19.1 to 237 mg m$^{-3}$ and 23.4 to 159 mg m$^{-3}$, respectively. In Building 1 and 2, the annual effective dose and the linear regression showed that the main source of pollutants in PM$_{2.5}$ were from the crustal source (20%) and combustion (21%), respectively. The effective lifetime carcinogenic risks (ELCR) in Buildings 1 and 2 were 1.90E-5 and 1.65E-4, respectively. The hazard quotient (HQ) represents the non-carcinogenic risk, with 7.73 and 6.46 in Building 1 and Building 2, respectively. The average equilibrium equivalent radon measured in Building 1 and Building 2 was 23.3 ± 0.99 and 3.17 ± 1.74 Bqm$^{-3}$, respectively. The average annual inhalation doses recorded at Buildings 1 and 2 were 0.014 ± 0.005 mSv y$^{-1}$ and 0.020 ± 0.013 mSv y$^{-1}$, respectively. For trace metals, the ECLR and HQ values were found to exceed the permissible limits suggested by US EPA; whereas the values of equilibrium equivalent radon concentration were still below the standard recommended by ICRP.

TU388
Paradigm for PM$_{2.5}$ Chemical and Biological Characterization: Paired Home and Personal PM$_{2.5}$ Samples in Kheri, India
C. Roper, A. Perez, Oregon State University / Department of Environmental and Molecular Toxicology; T. Kato, Oregon State University / College of Public Health and Human Sciences; S. Simenich, Oregon State University / Depts. of Chemistry and Environmental Molecular Toxicology; R.L. Tanguay, Oregon State University / Sinnhuber Aquatic Research Laboratory and the Environmental Molecular Toxicology

The global public health impact from household fine particulate matter (PM$_{2.5}$) is extremely large however, there is a limited understanding of health effects associated with specific PM$_{2.5}$ chemical constituents as well as the underlying mechanisms of these adverse health effects. These research gaps can be addressed through use of a high-throughput screening platform to quickly gain biological response data. A subset of homes in Kheri, India that participated in the Prospective Urban and Rural Epidemiological (PURE)-AIR pilot study were selected to identify differences in chemical and biological measurements of household PM$_{2.5}$. In 6 households, personal air monitors collecting PM$_{2.5}$ were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM$_{2.5}$ filters for each household. PM$_{2.5}$ was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM$_{2.5}$ samples of the same collection method were then pooled (n=6/group) and the soluble fraction of PM$_{2.5}$ from DMSO extraction was prepared for developmental toxicity testing performed in zebrasfish (n=32/treatment) starting at 6 hours post fertilization (hpf). Aliquots of the pooled samples were used for chemical analysis (polycyclic aromatic hydrocarbons (PAHs, n=20), elements (n=20)) and oxidative potential assessment with methods identified and chosen for the filters. Significant differences were observed in oxidative potential between personal and home PM$_{2.5}$ for both individual and pooled samples. Significant mortality in zebrasfish was observed starting at 24 hpf in personal PM$_{2.5}$ samples and by 120 hpf in home PM$_{2.5}$ compared to blank filter controls. Chemical analysis is underway to allow for correlations to be investigated between these biological responses and chemical constituents. This research is the first study to use paired home and personal PM$_{2.5}$ samples with chemical, oxidative potential, and developmental toxicity data, identifying the differences in these measurements between household and personal PM$_{2.5}$. Importantly, it outlines procedures for large-scale analysis of the PURE-AIR study which includes planned PM$_{2.5}$ measurements in 4,000 homes and will ultimately allow for correlation of human health effects with chemical and biological data to identify improved health metrics for PM$_{2.5}$ exposures.

TU389
Toxicity of airborne particulate matter as a factor to choose the most convenient school
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One of the critical decisions parents have to face is choosing a good school for their kids. Proximity, high ratio of teachers to students, and access to convenient educational infrastructures are the driving factors determining school’s choice. However it is used to assume that environmental air inside schools is safe enough.
Among the different air pollutants found in schools, PM$_{2.5}$ (airborne particulate matter smaller than 2.5 µm; also referred as "fine PM") is considered as the most injurious one. Since this pollutant is potentially very harmful, toxicity of PM$_{2.5}$ on lung cells has been widely studied. However, most of the publications on this topic are focused on studying PM$_{2.5}$ effects on human alveolar cells for short periods of time after applying doses far higher than environmental levels. To surpass this gap, we performed a present study. On it, we collected two fractions of fine PM (PM$_{2.5,10}$ and PM$_{2.5,0.1}$) in six classrooms of five schools located under the influence of three different environments: urban, petrochemical, and chemical. Subsequently, we exposed human alveolar epithelial cells (A549) to IC$_{50}$ doses obtained from a previous study. Then, apoptosis and release of 17 cytokines from the cells was studied after five different exposure times: 0, 6, 24, 48, and 72 hours. Preliminary results showed no differences in cytokines release when the two PM sizes or three sampling sites. However, differences amongst and comparing the levels of seven cytokines (MCP-1, TNF-α, INF-γ, G-CSF, IL-6, IL-7, and IL-8) versus exposure times. These differences became significant after 24-48 h from exposure, and increased till reaching the maximum value after 72 hours. Results from this study will be useful not only to better understand the way of action of PM$_{2.5}$, but also to schools managers and parents.

TU390
Acute Impacts of Extreme Hot Temperature Exposure on Emergency Room Y. Lan, C. Chang, C. Chung, China Medical University
Abstract The purpose of this study was to assess the effects of extremely high air temperature on hospital emergency room visits (ER) related to alcohol addiction and other mental illnesses in Taiwan. A time series study was conducted using health and climatic data from 2000 to 2010 in Taiwan. A national health insurance database, temperature database, and air quality surveillance database were used for this study. Relative risks (RRs) for increases in emergency room (ER) visits were estimated for alcohol addiction and other mental illnesses after exposure to extreme hot temperatures (99th percentile) on the daily mean temperature as reference. Poisson regression models using a distributed lag non-linear model (DLNM) were used. We adjusted for the effects of humidity and outdoor air pollutants. We found an association between alcohol addiction and other mental illnesses and mean daily temperature at 23.67 °C on ER visits. The association was strongest within 0–7 days after exposure to high temperatures. Increases (RR 1.02, 95% CI 1.01–1.04) in major depressive disorder (MDD) ER visits was observed over a cumulative period of 7 days after exposure to high ambient temperature (99th percentile vs. 50th percentile). The opposite association was reported for alcohol addiction (RR 0.99, 95% CI 0.98–0.99). No significant associations with anxiety, dementia, and delirium were estimated. Our findings suggest that extreme temperature poses a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU391
Characteristics of Polybrominated Diphenyl Ethers Released from Primitive E-Waste Treatment L. Li, Jinan University, J. Zhou, C. Wu, L. Bao, L. Shi, E.Y. Zeng, Jinan University / School of Environment
Abstract Primitive processing of e-waste potentially releases abundant organic contaminants to the environment, but the magnitudes and mechanisms remain to be adequately addressed. The present study conducted thermal treatment and open burning of typical e-wastes, i.e., plastics and printed circuit boards. Emission factors of the samples for temperature, polybrominated diphenyl ethers (PBDEs) and the upper limit (UL) of 81% of sum of seven PBDE congeners (RD – 9.14 × 10$^{-8}$ g m$^{-3}$) in thermal treatment and open burning, respectively. Airborne particles (87%) were the main carriers of PBDEs, followed by residual ashes (13%) and gaseous constituents (0.3%), in thermal treatment, while they were 30%, 43% and 27.2% in open burning. The output-input mass ratios of ΣPBDE were 0.21–10 in thermal treatment and 0.01–0.36 in open burning. All PBDEs were largely affiliated with fine particles, with geometric mean diameters at 0.61–0.83 µm in thermal degradation and 0.57–1.16 µm in open burning from plastic casings, compared to 0.44–0.56 and RL – 0.55 µm from printed circuit boards. The main emission mechanisms for lightly and heavily brominated BDEs were suggested to be evaporation and mechanical formation, respectively. The difference between the size distributions of particulate PBDEs in emission sources and adjacent air implicated a noteworthy redisposition process during atmospheric dispersal.

TU392
How risky is the schoolyard? An approach from chemical composition of particulate matter E. Kiyan, Setac Europe, Universitat Rovira i Virgili / Chemical Engineering; J. Rovira, Universitat Rovira i Virgili; J. Sierra, Faculty of Pharmacy University of Barcelona / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rovira i Virgili University / Department d'Enginyeria Química
Abstract According to last estimations, there are globally around 6.5 million deaths a year from the inhalation of PM. Most of them are due to cardiovascular and respiratory diseases, and most of those occur in the developing world. Among the different air pollutants found in schools, PM$_{2.5}$ (airborne particulate matter smaller than 2.5 µm; also referred as "fine PM") is considered as the most harmful one. This material consists on solid particles and liquid droplets suspended in the atmosphere having a diameter smaller than 10 µm. Since they can come from a wide array of different sources (i.e. traffic, industries, indoor dust) their physicochemical characteristics are very heterogeneous, and knowing them becomes important in order to assess its damaging potential. To improve the knowledge regarding physicochemical characteristics of PM that children are exposed in schools we conducted a study focused on finding out chemical characterization of PM$_{10}$, PM$_{2.5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). These three fractions of PM were collected in the schoolyard (high volume samplers TSI 870-DV, Tisch) and inside the classroom (low volume Sioutas cascade impactor, SKC) of 12 schools during two seasons (winter and summer). Subsequently, chemical characterization of the particles (through the analysis of metals, soluble ions and carbonaceous materials) was performed. Preliminary results showed that both indoor and outdoor levels of PM are higher in winter than in summer. Indoor/outdoor ratios of particles are varying, showing some schools higher PM levles outdoors, while the opposite phenomenon is observed in others. Consequently, concentrations of the different chemical constituents of particles are variable, although indoor particles tend to have higher shares of carbonaceous materials. Our results will be useful not only to schools managers and parents, but also to policy makers in order to assess risk coming from the inhalation of these materials.
Pn=0.0001, P=0.001 and P=0.0011) respectively. There were significant decreases in blood levels of vitamin C, vitamin E, glutathione peroxidase and catalase (P=0.002, P=0.0004, P=0.0001, P=0.0004) respectively in Cement Workers/Dealers compared to Controls. But no significant difference in SOD (P=0.627) on comparison of Cement Workers/Dealers with Non-Cement Workers (Controls).

There was significant decrease in blood levels of vitamin C (P=0.0147), SOD (P=0.0308), glutathione peroxidase (P=0.0498) and catalase (P=0.0013) respectively, but there was a positive significant correlation of catalase with SOD (r=0.4173). This study suggest that Exposure to cement Dust may lead to reduction in blood levels of vitamin C, Vitamin E, Catalase, Glutathione Peroxidase, and SOD in Cement workers/Dealers. The observed reduction/decreases in the antioxidants were progressive from control to Cement Dealers and to cement Workers. Key words: Cement dust, antioxidant, enzymes, vitamins

TU395

Implementing NH3 mitigation strategies in a pig farm: different approaches to evaluate the environmental impact. C. Baldi, Università degli Studi di Milano / Department of Environmental Science and Technology; S. Canapicchio, Università degli Studi di Milano / Department of Environmental Science and Policy; P. Fermo, Università degli Studi di Milano / Department of Chemistry; M. Guarino, Università degli Studi di Milano / Department of Environmental Science and Policy

Ammonia is an atmospheric pollutant causing acidification of soil, nutrient-N enrichment of ecosystems, and eutrophication of terrestrial and aquatic ecosystems. When in gaseous form, NH3 has a short atmospheric lifetime and usually deposits near its source. In the atmosphere it reacts with other compounds to form ammonium sulfate and ammonium nitrate aerosols, leading to the formation of secondary inorganic aerosol (PM_{10}) that are a potential health hazard. Due to their smaller diameter and increased atmospheric lifetime, these particulates are able to travel long distances before being dry or wet deposited to the ground surface. This allows them to travel from rural areas to urban locations where they mix and build up in the atmosphere leading to smog or transportation to other areas. The particular unfavorable meteorological and orographic conditions of the Po Valley make this one of the most polluted region of Europe. Particulate matter pollution often exceeds the EU standards and WHO air quality guidelines for health protection. Besides a main source of ammonia emissions, the agro-zoo-technical compartment plays a key role in the secondary PM formation. Indeed, secondary inorganic aerosol from NH3 accounts for 40% of PM_{10} mass at the urban sites, and its contribution is even bigger in the rural sites. This study aims at evaluating the environmental performance of different NH3 mitigation strategies applied to Italian pig farms. Different mitigation scenarios are compared, considering the application of soluble and insoluble. In the EU, available Technologies Reference document for the Intensive Rearing of Poultry and Pigs. Different strategies can be applied to determine the effectiveness of mitigation options: the SHERPA model or other approaches like Life Cycle Assessment can indicate the environmental benefits achievable with the different scenarios analyzed. Although techniques may be implemented and managed separately, they produce synergistic effect on the farm’s environmental performance. All integrated measures to reduce emissions of NH3 from pig farming will lead to a higher amount of nitrogen in the manure and to the amount that potentially be emitted to air as NH during the downstream process of manure storage and spreading. The reduction of NH3 emission from pig farming management steps can have a positive effect on NH3-related impact categories, such as PM formation, terrestrial acidification and eutrophication.

TU396

Development of an In Vitro Method to Evaluate the Inhalation Bioaccessibility of Particle-Bound Hydrophobic Organic Chemicals and its Effects of Particle Size S. Xie, Ping University; L. Bao, E.Y. Zeng, Jiang University / School of Environment

Bioaccessibility of particle-bound hydrophobic organic contaminants and its effects of particle size are significant for assessing the potential human health risk via inhalation exposure, but have not been clearly evaluated. To fill this knowledge gap, the present study develops an in vitro method to estimate the inhalation bioaccessibility potential of hydrophobic contaminants using lung fluids, i.e., artificial lysosomal fluid (ALF) and Gamble’s solution amended by dipalmitoyl-sn-glycerol-3-phosphocholine, with Tenax as the absorption sink. Polycyclic aromatic hydrocarbons (PAHs) were selected as the target compounds and the assay parameters such as incubation time and the influence of particulate load membrane were examined. Results have shown that the bioaccessibilities of individual PAH compounds increased with the increasing incubation time and reached the steady state within 10 days. None of significant difference was found for the individual PAH bioaccessibilities between with and without adding glass microfiber membrane into the incubation system. Furthermore, the PAHs absolute recoveries, calculated by sum of PAHs masses in Tenax, artificial lung fluid, and residual particle dividing the initial masses, were from 92% to 112% in ALF and 75% to 99% in Gamble’s solution, suggesting that this developed in vitro method could be well appropriate to evaluate the inhalation bioaccessibility to particulate hydrophobic organics matter. In addition, the PAHs bioaccessibility were found to increase with particle size, but decrease with the increasing hydrophobicity. It is noteworthy that via the inhalation of particle-bound PAHs was reduced by more than 90% if the size-dependent PAHs bioaccessibility and deposition efficiency were involved into the assessment.

TU397

Toxicity does not vanish into thin air - molecular mechanisms of air pollutant mixtures. Z. Novakova, Masaryk University; J. Novak, Masaryk University / RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Kukcuka, P. Pribylova, P. Prokes, Masaryk University / RECETOX; G. Lammel, Max Planck Institute for Chemistry / Multiphase Chemistry Department

Air pollutants represent a major health concern and outdoor air pollution is a main environmental risk factor for human health. It can directly affect human health and can contribute to higher incidence of chronic respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). However, recent evidence suggests that air pollution is also a risk factor for human cardiovascular disease (CVD) and cancer. Moreover, air pollution is a major contributor to global mortality. In the last few years, the number of studies has increased investigating the main mechanisms of air pollution-related adverse health outcomes, however, the role of the interactions between different pollutants and potential health impacts is less well understood. Evidence suggest the existence of a complex interplay of chemical factors, such as binding site competition, molecular weight, etc., which may influence the functional effects of the pollutants. Therefore, a better understanding of the molecular mechanisms of air pollutants acting in combination is needed to better estimate health risks associated with air pollution exposure. In this talk we will present the main findings on the molecular mechanisms of air pollutants acting in combination relevant for the cardiovascular system, and show how combining this knowledge with data on pollutant exposure and human exposure may help better estimate exposure to the pollutants and to better assess the public health impact of air pollution.

TU398

Human health assessment of air pollution exposure to tuberculosis risk in regions of Taiwan H. Lin, National Taiwan University; Y. Lin, National Health Research Institutes / National Institute of Environmental Health Sciences; Y. Yang, C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; C. Liao, National Taiwan University / Bioenvironmental Systems Engineering

BACKGROUND: Ambient air pollutants from anthropogenic sources play critical roles in the prevalence of tuberculosis (TB). Association between ambient air pollution and TB disease burdens should be clearly elucidated. Several studies found that air pollutants were highly likely to pose adverse effects on antimycobacterial immunity mechanisms, increasing risk of TB development. OBJECTIVE: The main objective of this study was to assess the contribution risks to TB incidences resulted from ambient air pollutant exposure. METHODS: A population-based probabilistic risk assessment framework was incorporated with air pollution concentration database and epidemiologic dose-response data to assess contribution risks of air pollutant-associated TB incidences in Taiwan regions. The contribution concept was quantified using the population attributable fraction (PAF). The air pollution-PAF relationships were assessed by employing a three-parameter Hill model based on hazard ratio data of TB exposed to air pollutants. The contribution of air pollution exposure to TB was evaluated by applying multiplications of PAF likelihood and TB incidence rates. RESULTS: Both under severe and moderate scenarios, the results revealed that the most likely air pollutants significantly contributing to TB incidences were carbon monoxide (CO) and nitrogen dioxide (NO2) in regions of Taiwan. Additionally, the particulate matter (PM10) and nitrogen oxides (NOx) also were likely to contribute to TB incidences in some regions. CONCLUSIONS: We suggested that the contributions of air pollutants mainly from diesel combustions (CO, NOx and NO2) to TB incidences are of great concern. Furthermore, the human health risk assessment framework provides an alternative perspective to interpret the effects of air pollution on TB burdens. Keywords: Human health risk assessment; Air pollution; Tuberculosis; Population attributable fraction; Probabilistic risk assessment.

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TU399
Towards green braking: comparative evaluation of toxicological profile of particles generated by traditional and innovative braking systems.
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The protection and improvement of air quality are key critical points of environmental planning, both local and international. The inhalation of contaminated air and airborne particles is definitely the main route of exposure to the most important pollutants, secondary only to the diet. Several respiratory and cardiovasculardiseases are associated with air pollution. Air pollution is responsible for 400,000 deaths per year in EU28. In 2013 outdoor air pollution was classified as carcinogenic to man (Group 1) by the International Agency for Research on Cancer, with a special attention to airborne dusts. In addition, powders can alter aquatic and terrestrial ecosystems when they reach the surface waters and soils as a result of transport and deposition events. Road transport and traffic contributes greatly to emissions of PM2.5 and PM10 and an important contribution to the non-exhaustive emission is due to the wear of brakes. The European LIFE+ COBRA (LIFE13 ENV/IT000492) project aims to create a safer alternative to the pads currently on the market, replacing the phenolic binder with a new cementitious hydraulic binder. The study here presented evaluated the eco-and toxicological potential of particulate matters generated in laboratory conditions using test benches capable of simulating vehicle braking cycles. PM2.5, PM10 and deposited non-airborne particles were collected. Fine and coarse particles were detached from the filters and dispersed in an alcohol solution for in vitro assessment of their toxicological potential with non-tumor breast epithelium BEAS-2B cells as model of the respiratory tract. Effects on cell proliferation and cytotoxicity were assessed daily by the MTS assay and the evaluation of DNA-release from damaged cells. Sublethal responses were also measured including oxidative stress, DNA damage, mitochondrial membrane potential and metabolic alterations. In order to evaluate the ecotoxicological effects on seedlings growth and root damages, cress seeds were exposed to standard soil contaminated with non-airborne particles. The innovative cementitious pads were comparable to traditional pads in terms of braking performance but showed significantly reduced airborne particles production. Results showed different toxicity between particles generated from traditional and innovative braking systems: in our experimental models, particles derived from cementitious pads were less toxic than those from the resin based pads.

TU400
Toxic oxidation transformation products of phenanthrene measured in laboratory generated secondary organic aerosol particles
A. Krasnogorova, O. Minakova, A. Worsnop, O. Grigorova, O. Lipiatov, E. Mikhailov, S.L. Massey Simonich, C. Roper, Oregon State University / Department of Environmental and Molecular Toxicology; A. Zelenyuk, Pacific Northwest National Laboratory; K. Suski, Pacific Northwest Laboratories

Oxidized transformation products (OTP) of polycyclic aromatic hydrocarbons (PAHs) haven in some cases, been demonstrated to be more toxic than their parent PAHs. The objective of this study was to identify the contributions of secondary organic aerosol (SOA) particles that originate from reactions of phenanthrene (an abundant component of secondary organic aerosol). Recent laboratory studies indicate that SOA particles formed in the presence of gas-phase PAHs contain both parent PAHs and their OTP. In laboratory experiments of α-pinene SOA particles, OTP of phenanthrene, a model three-ringed PAH, were observed in varying ratios. Developmental toxicity testing with zebrafish (Danio rerio) will be conducted using embrios (n=32/treatment) that will be dechoronated and placed into 96-well plates containing OTP of phenanthrene in observed ratios at 6 hours post fertilization. Developmental toxicity will be assessed by evaluating morphological changes, embryonic/larval photometer behavior, and mortality at 24 and 120 hours post fertilization. Evaluation of the oxidative potential of the SOA samples as well as individual compounds and observed ratios of compounds is underway using the dithiobis(threitol) (DTT) consumption assay. The results from both assays will be discussed.

TU401
Chemical analysis and risk assessment for toxic compounds in PM2.5 in Gwangju, Korea
L. Kim, Gwangju Institute of Science and Technology; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

Particulate matter (PM), a mixture of solid or liquid matter found in the air, has gained considerable attention as a major air pollutant in recent years. Recently, it is revealed particulate matter, especially PM2.5 (aerodynamic size < 2.5μm) cause numerous diseases such as respiratory, cardiovascular diseases, asthma and so on. The prime criteria for preventing the adverse effects of PM2.5 are based on the mass concentration, but recent research has shown that the chemical composition of PM2.5 can be a more important factor for determining PM2.5 toxicity than mass concentration. Many researchers reported the diverse chemicals in PM2.5 such as inorganic sulfates and nitrates, black carbon, metal, organic compounds, and others. In addition, a few studied detected organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) in PM2.5 of China. However, there is no researches on OCPs and PCBs within PM2.5 in Korea. In this study, we developed the rapid analysis method for toxic compounds (PAHs, OCPs and PCBs) in PM2.5 using accelerated solvent extractor (ASE) and secondary particle mass spectrometer (SPMS). This study site in Korea was collected from Oct. 2016 to Apr. 2017 (for 21 weeks). We determined the toxic compounds in the collected PM2.5 using the developed method and metal concentration in PM2.5 was also analyzed using microwave extraction. Cr. As and Cd showed high concentration in PM2.5 of all sites and several OCP and PCBs also detected. Lastly, we did the risk assessment on metals, PAHs, OCPs and PCBs in PM2.5 of Korea to determine the risk of OCPs and PCBs among the total risk of PM2.5. Our research is a valuable report on OCPs and PCBs in PM2.5 of Korea and suggests the practical method for screening trace toxicants in PM2.5.

TU402
Source apportionment study of PM10 and PM2.5 using selective wind direction sampling technique in the area of Civitavecchia (Italy)
G. Gagliardi, Istituto Superiore di Sanità / Environment and Health; G. Settimi, M. Inglessis, Istituto Superiore di Sanità / Department of Environment and Health; G. marsili, osservatorio ambientale; m. soggiu, Istituto Superiore di Sanità / Department of Environment and Health

The contributions of statistical analysis of matter (PM) and their attribution to specific sources through the source apportionment methodologies is an important research topic in air quality study; in fact, the possibility to discriminate between different emission sources and between natural and anthropogenic contribution is a key issue for planning efficient air pollution reduction and mitigation strategies. Moreover, the knowledge of the chemical composition of PM for the different size fractions is recognized as increasingly important, in particular with respect to health effects of exposed population. The aim of the study is the characterization of PM10 and PM2.5 main sources located in the Civitavecchia harbour-industrial area (Central Italy), namely a large coal-fired power plant, a natural gas power plant, the harbour area, the vehicular traffic (due to both the local traffic and the highway crossing the area) and small industrial activities located in the town. To this purpose, the approach based on the use of PM samplers coupled with a wind-select sensor, allowing a selective PM10 and PM2.5 sampling downward to specific emission sources, has been used. Furthermore, the chemical characterization of the PM collected has been carried out in order to explain specific emission patterns, and to assess the concentration levels of the micro-pollutants emitted by local sources and particularly toxic for health. Two sampling sites have been identified in the area, respectively urban and urban background site, and equipped with a PM10 and PM2.5 wind-select sampling device, designed to collect airflows from two directions, downwind respectively the coal-fired power plant and the port area. Samples of PM10 and PM2.5 were monthly collected for one year, and chemical analyses were performed to determine the concentrations of organic and inorganic species. A descriptive and comparative analysis of data was performed, also verifying the occurrence of legislative threshold exceedances. Moreover, in order to highlight the contribution of specific sources, the differences in the measured micro pollutants concentrations between wind directions, PM size factions and sampling sites have been investigated, as well as the seasonal trends of pollutants concentrations. These results allow to highlight that the applied methodology represents a valid support in source apportionment studies. Keywords: source apportionment, wind select-sampling device, PM10, PM2.5

TU403
Forecasting global atmospheric visibility based on air quality and meteorological data
H. Xiao, NUEORS, Chinese Academy of Sciences / NUEORS; J. Zhang, L. Tong, H. Yi, M. He, J. Zheng, IUE, Chinese Academy of Sciences

Simultaneous and continuous measurements of visibility, meteorological parameters, including relative humidity, and the concentrations of six atmospheric pollutants (PM2.5, PM10, SO2, NO2, CO, O3) were obtained for several cities around the globe. The characteristics of visibility and relationships with air pollutants and meteorological factors were investigated using multiple statistical methods. Analysis demonstrated that within a certain relative humidity range, visibility is the exponential function of the PM10 concentration. Thus, non-linear models combining multiple linear regressions with exponential regression were subsequently developed to describe the hygroscopic growth and the attenuation effects of the air pollutants. The results of the developed models can quantitively describe the relationships between visibility, air quality and meteorological parameters around the whole globe.

TU404
Analyzing the Asian supply chain structure of health impacts with PM2.5 including secondary particle
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Countries and regions in Asia have played an important role in producing intermediate products and final commodities today and supplied their products around the world. Productions and consumptions of goods and services in the Asian countries have clearly contributed to the economic growth in the world, whereas those economic activities brought about environmental loads. Particularly, China’s emissions of air pollutants such as fine particulate matter (PM$_{2.5}$) have caused some severe environmental and public health problems in China. To estimate the health impacts associated with the PM$_{2.5}$ through the Asian supply chains have been estimated in the previous researches. While these analyses showed what production activities induced these health hazards caused by “primary” PM$_{2.5}$, almost of these studies doesn’t include the effects of “secondary” PM$_{2.5}$. This study developed the secondary PM$_{2.5}$ concentrations emitted on every industry and region by using Emission Sources Database for Global Atmospheric Research (EDGAR) emission inventory data, Weather Research and Forecasting (WRF) model and CMAQ modeling system, and then estimates the induced mortality data in Asia. We further applied structural path analysis (SPA) to the Asian International Input-Output Table (AIIOIT) to clarify the critical supply chains for the reduction of health impacts in Asia. The result shows that the Japan’s consumption-driven demand on PM$_{2.5}$ emissions in Asian were estimated 86kt-C, and we revealed top ranking supply-chain paths for PM$_{2.5}$ emissions induced by Japan’s final demand. The most significant supply-chain path with the highest emissions was the path from transportation sector in China to Japan’s final demand, and subsequently the path, other food products sector in Thailand –> food crops sector in Thailand –> Japan’s final demand. We also argued the health impacts caused by the trans-boundary pollutions in Asian countries.

TU405 Source contributions to PM10 levels in a coastal area in northern France: a one-year study

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The Hauts-de-France Region is one of the most concerned areas in France by exceedances of the PM$_{10}$ daily mean limit value (50 μg.m$^{-3}$). For a better understanding of these phenomena, the identification as exhaustive as possible of the main PM$_{10}$ contributing secondary PM$_{2.5}$ emissions in this coastal area in northern France was performed on the identification of particles from terrestial sources. The objective of this work is to fill the lack of knowledge about the impact of emissions resulting from the marine compartment. It includes natural emissions such as sea salts [1] and anthropogenic emissions linked to the marine traffic especially in the English Channel, that forms a narrow corridor with one of the greatest shipping concentrations in the world (up to 800 vessels sailing per day). PM$_{10}$ sampling and monitoring campaign were performed continuously during one year in 2013 at Cape Gris-Nez, a coastal French site located in front of the Straits of Dover. PM$_{10}$ levels were measured using MPI101 analyzer (Environment SA®) and collected using the DAB0 sampler (Digite®f, 30 m$^{-3}$) on a daily basis. The characterization of PM$_{10}$ was performed considering major and trace elements, water-soluble ions (EC/OC as well as tracers of biomass burning (levoglucosan)), primary biogenic emissions (arabitol, mannitol) and marine biogenic emissions (methanethiol sulfonate ions). These chemical parameters were used to explain PM$_{10}$ levels on the coastal site, identify PM$_{10}$ sources and estimate their contributions. Sources profiles were identified from the use of a Constrained Weighted non Negative Matrix Factorization (CNMF) model: fresh sea-salts, aged sea-salts, secondary nitrates, secondary sulphates, crustal, biomass combustion, primary biogenic emission, marine traffic, combustion, metal source. The monthly evolution of their contribution evidenced different behaviours between the sources: secondary nitrates were predominant during the cold season and appeared to be the most involved in the PM$_{10}$ concentration peaks. The impact of marine traffic and a high proportion of aged sea-salts versus fresh sea-salts was mainly evidenced during the summer season. For the year 2013, the mean contribution of the different sources were 37% for sea-salts and aged sea-salts, 43% for the secondary inorganic aerosols, 7% for biomass combustion, 5% for marine traffic. This distribution varies highly depending on the period and more particularly during exceedances of daily PM$_{10}$ limits values.

TU406 Source-to-exposure assessment of industrial pollutants in Australia, using the Pangea multi-scale framework

C. Wannaz, The University of Michigan, Ann Arbor / SPHEHS; P. Fanke, Technical University of Denmark / Quantitative Sustainability Assessment Division; J. Lane, University of Queensland, Brisbane; O. Jolliet, University of Michigan

Effective planning of airshed pollution mitigation is often constrained by a lack of integrative analysis able to relate the relevant emitters to the receptor populations at risk. Both emitter and receptor perspectives are therefore needed to consistently inform emission and exposure reduction measures. This presentation aims to extend the Pangea spatial multi-scale multimedia framework to evaluate source-to-receptor relationships of industrial sources of organic pollutants in Australia. Pangea solves a large compartmental system in parallel by block to determine arrays of masses at steady-state for 100,000+ compartments and 4,000+ distances, versus formaldehyde that has a more local impact. Decomposing exposure per industrial sector shows petroleum and steel industry as the highest contributing industrial sectors for benzene, whereas the electricity sector and petroleum refining contribute most to formaldehyde exposures. The source apportionment identifies the main sources contributing to exposure at five locations of interest. Overall, this presentation demonstrates the relevance of addressing both exposures from both an emitter perspective well-suited to inform product oriented approaches such as LCA, and from a receptor perspective for health risk mitigation.

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Environmental monitoring is a growing concern in both developed and developing countries. Air quality monitoring is usually performed with specialized equipment and analytical methods by regulatory agencies and researchers. However, EU projects guidelines report the need to involve also citizens in environmental monitoring, thus low-cost and easy-to-use technologies are required. To achieve this aim, novel sensors for environmental monitoring have been designed and developed to date to obtain reliable values comparable to those provided by standard methods and techniques. Currently, electrospinning is considered as one of the most versatile and inexpensive manufacturing technologies to obtain microfibers and develop nanofibers and nanofibrous and biodegradable organic compounds (VOCs) in the air. Sensors based on polymeric fibers look extremely attractive for the low cost and great versatility of the raw materials that can be easily tunable, according to the transducer used and the application of interest, taking part to the resulting sensing features (selectivity and sensitivity). Therefore electrospun nanofibrous and environmentally friendly materials have been designed and fabricated for detecting pollution. Polymer windscreen has been focused on the challenging goal of obtaining conductive sensors for the monitoring of air pollutants employing suitable scaffolds of eco-friendly (polyhydroxybutyrate) and sustainable (recycled) nanomaterials (polystyrene).

Indeed biodegradability is a noteworthy feature to obtain sensing tools environmentally friendly and safe for health. However, sensors for gas monitoring must also be able to both persist intact for a useful shelf life and to preserve their sensing features over time, depending on the specific application and the working period. Finally, the selectivity of fibers can be tuned by introducing differently functionalized macromolecules (Me-tetraphenylporphyrins) that are sensitive to several classes of gas and VOCs. The conductivity of the planned sensors has been implemented by adding conductive nanoparticles (e.g. graphene’s flakes). Rapid microplastics analysis has been developed using an electrospun bio-film as a transducer matrix. This and similar devices, have been used to develop sensors for the monitoring of plastic particulates. Plastic particles were detected and counted using an electrospun bio-film. In situ analysis has been proved to be an appropriate technique to monitor the concentration of plastic particles in indoor air. The development of new solutions for the use of microplastics in the future is still required.

**TU409**

**Microplastic Indoor Air Pollution Using a Simulated Breathing Mannequin**

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Extensive research has been performed on indoor air quality (IAQ) over the last 30 years. This includes the investigation of the location and position of indoor air pollution sources. Microplastics in indoor air are a relatively new area of research. Microplastics are defined as plastic particles with a size ranging from 1 to 5 mm. The presence of microplastics in indoor air has been reported in numerous studies. The concentration of microplastics in indoor air is still not well understood. The aim of this study is to determine the concentration of microplastics in indoor air using a simulated breathing mannequin. The mannequin takes in air through the mouth, which is led through a copper pipe to the filtering unit. The copper pipe filters the air and collects microplastics onto the surface. The samples are then analyzed using a microplastics analysis system. The system is capable of detecting microplastics down to 0.1 mm. The results indicate that microplastics are present in indoor air. The concentration of microplastics is relatively low. This study shows that microplastics are present in indoor air and that further research is needed to determine the impact of microplastics on human health.

**TU410**

**Composite electrospun fibers based on sustainable and biodegradable polymers for monitoring air pollution**

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Environmental monitoring is a growing concern in both developed and non-developed countries. Air quality monitoring is usually performed with specialized equipment and analytical methods by regulatory agencies and researchers. However, EU projects guidelines report the need to involve also citizens in environmental monitoring, thus low-cost and easy-to-use technologies are required. To achieve this aim, novel sensors for environmental monitoring have been designed and developed to date to obtain reliable values comparable to those provided by standard methods and techniques. Currently, electrospinning is considered as one of the most versatile and inexpensive manufacturing technologies to obtain microfibers and develop nanofibers and nanofibrous and biodegradable organic compounds (VOCs) in the air. Sensors based on polymeric fibers look extremely attractive for the low cost and great versatility of the raw materials that can be easily tunable, according to the transducer used and the application of interest, taking part to the resulting sensing features (selectivity and sensitivity). Therefore electrospun nanofibrous and environmentally friendly materials have been designed and fabricated for detecting pollution. Polymer windscreen has been focused on the challenging goal of obtaining conductive sensors for the monitoring of air pollutants employing suitable scaffolds of eco-friendly (polyhydroxybutyrate) and sustainable (recycled) nanomaterials (polystyrene).

Indeed biodegradability is a noteworthy feature to obtain sensing tools environmentally friendly and safe for health. However, sensors for gas monitoring must also be able to both persist intact for a useful shelf life and to preserve their sensing features over time, depending on the specific application and the working period. Finally, the selectivity of fibers can be tuned by introducing differently functionalized macromolecules (Me-tetraphenylporphyrins) that are sensitive to several classes of gas and VOCs. The conductivity of the planned sensors has been implemented by adding conductive nanoparticles (e.g. graphene’s flakes). Rapid microplastics analysis has been developed using an electrospun bio-film as a transducer matrix. This and similar devices, have been used to develop sensors for the monitoring of plastic particulates. Plastic particles were detected and counted using an electrospun bio-film. In situ analysis has been proved to be an appropriate technique to monitor the concentration of plastic particles in indoor air. The development of new solutions for the use of microplastics in the future is still required.

**TU411**

**Determination of Cross Compartment Concentration Gradients of Polycyclic Aromatic Hydrocarbons using PE Passive Samplers**

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Several polycyclic aromatic hydrocarbons (PAHs) are considered as human carcinogens or toxic to reproduction, and are thus a relevant class of “substances of very high concern” according to the European Chemicals Legislation REACH. Emission of PAHs is mainly caused anthropogenically by the incomplete combustion of fossil fuels. Due to the hydrophobic behaviour of these compounds a significant accumulation within soils has been observed. Recently decreasing atmospheric concentrations could trigger a change of equilibrium conditions between soil and atmosphere. This illustrates the main objective of the study: The determination of the actual flux direction of PAHs across the soil-atmosphere interface in order to deduce the atmospheric concentration over time. Atmospheric monitorings have been conducted seasonally for two subsequent years using 80 µm thick PE sheets at three rural sites. During the second year an additional height has been implemented as well as active sampling. Soil samples were taken at each location at several intervals up to 50 cm depth and equilibrated ex situ with 30 µm thick PE sheets. A numerical approach, based on the double film diffusion model, was applied to the experimental data in order to deduce the atmospheric concentration over time. Seasonal deployments illustrate significant variations with 10 fold higher PAH concentrations in the atmosphere during winter compared to summer monitoring. Concentrations within the soil depicted homogeneous profiles, considering PE as representative PAH concentrations in the soil were in the range of 100 ng/g PE after equilibration. In contrast concentrations on the PE in the atmosphere vary between 70 ng/g during summer and 1200 ng/g during winter monitoring. This explicit difference between soil and atmosphere during colder months indicates a main flux direction into the soil.
Kekulé resonance structures, 2) thermodynamic stability of all possible OH-PAH adduct intermediate, 3) electron density at each carbon on the PAH and 4) average local ionization energy (ALIE) at atom or bond sites. To evaluate the accuracy of these approaches, the predicted PAH-TPs were compared to published laboratory observations of major NPAAH, OPAH, and OHPAH products in both gas- and particle-phases. We found that the Clar’s resonance structures were able to best predict the low molecular rings of the PAHs, but did not offer insights in terms of which carbon is most reactive. All other computational approaches provided specificity in their predictions, yet the ALIE approach was the most superior in accuracy, when compared to laboratory data. The high predictive capability of ALIE shows great potential for the prediction of the formation of previously unstudied PAH-TPs that are likely to form in the atmosphere. Furthermore, the resulting computational chemical descriptors to prioritize which PAH-TPs might be formed in the environment; the organic chemists to prioritize which PAH-TPs should be synthesized to verify their presence in the environment; and the toxicologists to prioritize which PAH-TPs should be analyzed for their toxicity and potential human health implications. Future direction of the study is to expand the prediction to screen for PAH-TPs from other parent-PAHs as well as alkylated-PAHs.

TU413 Spatial distribution of gas-phase Polycyclic Aromatic Hydrocarbons along South America and Antarctica
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Polycyclic Aromatic Hydrocarbons (PAHs) are a large group of compounds with two or more condensed aromatic rings. These compounds are emitted from various sources to the atmosphere and some of them are known by their carcinogenic or mutagenic properties. However, qualitative information is limited about PAHs in air, and normally rely on the availability of active sampling techniques, usually expensive and laborious, needing power source, inexistent in remote areas. Conversely, passive sampling allows easy and cheap handling atmospheric appraisal even in remote regions. Thus, the present study evaluated PAHs levels throughout the South American environment employing XAD2-based passive atmospheric sampling (PAS). The Latin American Atmospheric Sampling Network (LAPAN) has begun in 2010 by deploying a pair of PAS containing one cartridge of XAD2 resin on each site. Resins were deployed for 12 months during 3 consecutive years at 42 sites (16 sites in Brazil and 26 distributed in Argentina, Chile, Peru, Uruguay, Venezuela and Antarctica) covering different backgrounds (rural, urban / industrial and remote). Passive samplers and XAD2 resins were prepared as described by Wania et al. (2003). XAD-2 resins were extracted by hexane: dichloromethane (1:1), purified and analyzed by gas chromatography/mass spectrometry (GC/MS). The concentration of PAHs was greater than inhalation. The results help: the environmental chemists to prioritize which PAHs to monitor due to their sensitivity to SOx and NOx, as well as their biota concentration of airborne material. This study incorporates characterization of particulate matter (PM) on the surface of lichen Ramalina farinacea to map exposure to air pollution in three industrial clusters in Seattle, Washington, USA. The PM was characterized using scanning electron microscopy with energy-dispersive X-ray spectroscopy mapping to determine PM size and composition. We also measured biomonitoring of certain PAHs in the lichen and the biomonitoring results indicate that dermal absorption is a significant exposure route of PAHs. In the case of BBQ fumes, dermal absorption is a more important pathway for intake of low molecular-weight PAHs than inhalation.

TU416 TBARS in horse hair as an indicator of oil industry pollution
M. Kočárová, Department of Biology, University of Ostrava; T. Plavac, B. Kutuzová Hackenberger, University of Ostrava / Department of Biology
Air pollution is a major problem today. Although there are many tests that measure the presence of certain substances in the air, it is important to measure the impact of various air pollutants on living organisms as well. Horses that spend time outdoors are exposed to environmental influences, and some of them are measurable in horse hair. The aim of this study is to assess how pollutants of the oil industry affect biological markers in permanent horse hair from mane and tail and whether the concentration of thiobarbituric acid reactive substances (TBARS) can be used as biomarker of oil industry air pollution. The horse hair samples from mane and tail were collected from two areas. One near Slavonski Brod, where an issue of air pollution is present due the outdated refinery plant in Bosanski Brod, and the other near Ošiek where no apparent air industry pollution is present. The concentration of TBARS was measured fluorometrically. The samples were cut into segments to detect differences in duration of exposure through the age of hair. The concentration of TBARS was significantly higher in hair exposed to polluted air (Slavonski Brod site). When segments were analysed according to the age of hair it was noticed a constant difference in concentration of TBARS between roots and top for mane and tail. A significant correlation between age of hair and concentration of TBARS was noticed. Although further research is needed, a concentration of TBARS in horse hair could serve as a simple and inexpensive method for monitoring air pollution by oil industry.

TU417 Morbidity for environment-related diseases in La Spezia, northwest Italy: an epidemiological analysis on hospital discharge rates
F. Lucarini, University Rome Tor Vergata / Department of Biomecience and Prevention; A. Pietruzione, A. Ronchi, Department of Police and Criminal Analysis / Department of Biomecience and Prevention; N. Toschi, University Rome Tor Vergata; A. Duggento, University of Rome Tor Vergata / Department of Biomecience and Prevention; C. Alessandri, C. Ambrosone, L. Palombi, University Rome Tor Vergata
Background. La Spezia Province, northwest Italy, is a potentially high risk area because of the massive presence of industrial and harbor activities. Only controversial evidence of their health impact in the area is available at the moment. Therefore, a comprehensive survey on potentially environment-related disease would be really useful. Methods. Liguria Region hospital discharge records from 2001 to 2013 have been collected. Only admissions for cardiovascular disease, respiratory disease or neoplasms as primary diagnosis were included. Hospital discharge rates, standardized by age and compared with Regional mean, were represented using geographic maps with a color scale identifying different disease distribution. For those disorders showing significant difference with regional mean, disease distribution was compared with emissions of air pollutants, estimated by Lichen biomonitoring. Results. La Spezia Province Hospital Discharge rates for potentially environment-related disease were significantly different compared with those of the Liguria Region. Malignant melanoma, chronic bronchitis and myocardial infarction rates were higher both in men and women (with a percentage increase of 84% and 87%, respectively, for malignant melanoma; +22% and +47% for chronic bronchitis and +40% and +41% for myocardial infarction). Conversely, hospital discharge rates for diabetes and hypertensive cardiopathy were lower than those of the Liguria Region. 50% among males and 49% among women for the first and 56% and 54%, respectively, for the second. Comparing these results with Lichens maps, no evidence of a clear correlation between emissions of air pollutants and regional distribution of diseases was available. On the contrary, diseases differing the most
from Regional mean were mainly distributed in areas with scarce anthropic activity. 

Conclusions. No clear morbidity trend is identifiable for La Spezia Province from 2001 to 2013. Also disorders belonging to the same pathological class showed to increased (from day 0 to day 40) as well as decreased for some compounds that the tested compounds pose limited risks when presented in the soils for a given term environmental threat with a wide range of possible negative impacts on ecosystem services and health. Hence, risk assessment considering vector-borne groups of vertebrates, invertebrate and plant species, should be performed. The objective of the present work was to assess the ecological risks of conazole fungicides based on the data from the comprehensive survey of pesticide residues in 75 agricultural topsoil floodplain locations in the Czech Republic acquired in early 2015 [2]. In this study, 51 currently used pesticides and 9 transformation products were analysed by multi-residue pesticide analysis on LC-MS/MS after soil QuEChERS extraction. The data indicated that over 70% of soils contained at least one CF and the total concentration of CFs exceeded 0.01 mg/kg in 53% of soils. Epoxiconazole and tebuconazole also frequently exceeded 0.01 mg/kg (in 25% and 32% of soils, respectively). High concentrations of CFs were epoxiconazole (48% of soils) and tebuconazole (36%), followed by diflubenzuron, fludioxonil, prochloraz (23%), prochloraz (22%), propiconazole (13%), cyproconazole (8%) and difenoconazole (7%). Overall, the CFs fungicides are of environmental concern because they exceeded risk based thresholds, tend to form long-term residues in soil and rank among suspected carcinogens and endocrine disruptors. [1] EU pesticide database ec.europa.eu/food/plant/pesticides/pesticidesdatabase. [2] M. Hvezdova, et al., Sci. Total. Environ., vol. 613–614, pp. 361–370, 2018.

TU421 Concentration- and time-dependent dissipation, partitioning and plant accumulation of selected fungicides, insecticide, herbicide and transformation products in sand and soil N. Neuwirthová, Masaryk University; Z. Bílková, Masaryk University / RECETOX; J. Vasickova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Břelská, Masaryk University / Faculty of Science RECETOX In this study, the dissolution and partitioning dynamics and the extent of biotopack was measured and modeled for selected hazardous current-used fungicides (prochloraz, tebuconazole, fluazinam, epoxiconazole, insecticide (chlorpyrifos), herbicide (pendimethalin) and for a transformation product (2-hydroxyatrazine) in agricultural soil and quartz sand as representatives of a real and a worst-case scenario. Dissipation, uptake to Lactuca sativa and the freely dissolved concentration along with the non-ionic fraction was measured for selected fungicides and metabolites (Koc) were determined on day 12, 40 and 90 following the application of compounds at three fortification levels (0.1 – 1.0 – 10 mg/kg). Dissipation of tested compounds differed in soil and sand and was influenced by compound concentration. 2-hydroxyatrazine showed the longest persistence in soil among the tested compounds. The four fungicides showed very similar dissipation patterns and were more persistent in sand than in soil which implies that their main elimination mechanism in the environment is biodegradation. Plant roots were shown to accumulate higher amounts than shoots with root-to-shoot translocation factors (TFs) of 0.007–0.14 where the extent of root uptake was driven by compound partitioning. This was evidenced by the ability of Cmax to reliably (r = 0.94) predict root uptake. Concentrations in shoot did not exceed the maximum residue levels (MRLs) for lettuce. Koc values were in the range of literature values and were shown to increased (from day 0 to day 40) as well as decreased for some compounds (from day 40 to day 90) with time probably as a result of compound sequestration and competitive sorption, respectively. From the results, it follows that the tested compounds pose limited risks when presented in the soils for a given time, they shown to be not persistent (except for 2-hydroxyatrazine), b) to accumulate in lettuce to extents below MRLs, c) to sorb effectively to soil, even in the presence of other co-solutes.

TU422 Evaluation of pesticides and fungicides transport using passive sampling devices in a vineyard catchment in South West France J. Gaillard, Université de Bordeaux / EPOC UMR 5805; M. Dévier, University of Bordeaux / EPOC / LPTIC UMR 5805 CNRS, K. Le Menach, P. Pardon, UMR CNRS EPOC Université Bordeaux / EPOC UMR 5805; G. DUPORTE, Université de Bordeaux / EPOC UMR 5805; F. Macary, Iristea Bordeaux; H. Budzinski, University of Bordeaux. In vineyards of South West France, fungicides account for nearly 8 out of 10 pesticide applications which increases the likelihood of chronic exposure in adjacent ecosystems. The objective of the present study was to investigate the dynamics of pesticides and fungicides from agricultural drainage ditches to a third order stream in a vineyard catchment. Monitoring was a combination of passive and grab water sampling. Six sites with continuous-flowing (POCIS) were monitored during a year using polar organic chemical integrator sampler (POCIS) retrieved monthly together with grab water samples collected monthly or bimonthly. Four sites with intermittent-flowing were monitored using grab water samples only. Passive samplers such as POCIS enable the improvement of limits of quantification (LOQ) and estimation of time-weighted average concentrations over the exposure period for polar organic compounds. Overall, the 25 pesticides were targeted including 23 fungicides currently applied in the studied catchment. Extracted samples were analysed by liquid chromatography-tandem mass spectrometry (LC-MS/MS) and gas chromatography-tandem mass spectrometry (GC-MS/MS). Among the currently used pesticides in the catchment, preliminary results obtained from a sampling campaign conducted in spring allowed the quantification of 19 fungicides, 3 herbicides and 1 insecticide in passive samplers. In water samples, 9 fungicides and 1 insecticide were detected.Highest concentrations (1 µg/g) were measured for the fungicides benalaxyl and dimetomorph. Fungicides such as cyprodinil, kresoxim-methyl and iprovalicarb
were detected in passive samplers but were not detected in water samples suggesting the importance of combined sampling techniques to provide a more complete assessment of fungicide exposure in vineyard catchments.

TU423
Assessment of secondary exposure to fungicide residues in fruit-growing workers were among the participants of the CANEPA project (Cancers and Exposures to Agricultural Pesticides) aims to characterise external contamination of agricultural workers and environmental contamination by pesticides in arboriculture. In this work, we assessed the deaths of Korean victims who were exposed to the disinfector, G. DUPORTE, J. Gaillard, Université de Bordeaux / EPOC UMR 5805; E. Barron, University of Bordeaux, CNRS / EPOC UMR 5805; K. Le Menach, P. Pardon, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5805; I. Baldi, University of Bordeaux / ISPED, EPIcene; F. Macary, Inreca Bordeaux; M. Dévier, University of Bordeaux / EPOC / LPTF UMR 5805 CNRS; H. Budzinski, University of Bordeaux, France. European Union countries have about 12 million agricultural holding, and approximately 172 million hectares (39% of the total European land surface) of agricultural areas. Pesticides are used extensively in agricultural production to prevent pests, diseases, weeds or other plant pathogens to reduce yield losses and to guarantee a good harvest. In the recent decades, numerous studies have suggested adverse health effects associated to long-term pesticide exposure. Serious concerns have been raised about health risks resulting from occupational exposure. Nevertheless, the knowledge of occupational exposure levels and determinants to pesticides are still limited. The CANEPA project (Cancers and Exposures to Agricultural Pesticides) aims to characterise external contamination of agricultural workers and environmental contamination by pesticides in arboriculture. In this work, we assessed the deaths of Korean victims who were exposed to the disinfector.

TU424
Intra-tracheal administration of the disinfectant, chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), in a mouse model to evaluate a causal association with death

Y. Park, GLP Center, Catholic University of Daegu / APT; H. Kim, Graduate School of Medical Health Science, Catholic University of Daegu; B. Kang, Catholic University of Daegu, Graduate school of toxicity assessment. The objective of the study was to evaluate the potential of CMIT/MIT to induce respiratory injury. CMIT/MIT, have remain unsolved. This is mainly due to a lack of concordance between the few available toxicity tests and the abundant epidemiological data, thus making it difficult to establish a cause-and-effect relationship. Therefore, this study was carried out to investigate any potential associations between CMIT/MIT exposure and death. Methods: Groups of experimental and control C57BL/6 mice were instilled in the trachea with 10 μl of 200 mg/mL chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), using a visual instillation. CMIT/MIT was instilled over a period of 3 days and 8 weeks, respectively, to achieve acute and chronic exposures. A threshold dose-response model was applied for estimating the threshold level as one line of evidence for a causal association with death.

TU425
Genotoxic response and alteration of intracellular redox balance in Hep-2 cell line by exposure to Iprodione

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TU426
Toxicological effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826): laboratory and field investigations

T. Campani, I. Caliani, C. Pozzuoli, L. Poggioni, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Casini, University of Siena / Science E. The cells were exposed to the insecticide CMIT/MIT in a dose-dependent manner, with the highest dose of treatment the recommended one for practical use.

TU427
Potential Salinity Enhanced Impacts of the Phototoxicity of the Fungicides to Inland Silversides, Menidia beryllina

SETAC Europe 28th Annual Meeting Abstract Book
Dichlorodiphenyltrichloroethane and pentachlorophenol are two active ingredients in fungicides commonly used in the United States that readily undergo photolysis in the presence of sunlight. Both pesticides have reported half-lives in seawater and freshwater. While the rate of degradation and the half-life of dichlorodiphenyltrichloroethane is improved by the seawater (7.5 hours), the distribution of intermediate products is altered significantly; 2-chloro-1,4-benzoquinone forms at nearly double the concentration in seawater as opposed to freshwater. Dichlorodiphenyltrichloroethane quickly degrades to 4-hydroxydichlorodiphenyltrichloroethane via soil degradation and hydroxylchlorodiphenyl can desorb back into the water column where it can be photochemically degraded. The degradation rate and half-life of chlorodichloroethane is very short, but differs significantly between freshwater (32.5 min.) and seawater (301 min.). Both dichlorodiphenyltrichloroethane and pentachlorophenol have similar proposed photodegradation pathways, therefore the potential for enhanced phototoxicity due to salinity variation is possible. Dichlorodiphenyltrichloroethane has been observed to be phototoxic to invertebrates at concentrations as low as 0.10 mg/L, with >90% mortality at 0.75 mg/L. Adverse sub-lethal impacts have also been observed, such as an upregulation in the CCL28 and PTGS2 genes. The effects of salinity on chemical toxicity may warrant changes to future chemical assessments.

**TU428**

**From mother to offspring: multigenergenerational effects of carbendazim at individual and subcellular levels in Daphnia magna**

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Anthropogenic activities such as the use of pesticides may have indirect disastrous consequences on marine organisms. Among these, the fungicide carbendazim, which has a high potential to end up in aquatic ecosystems mainly through runoff. The deleterious effects observed at the population level can often be depicted or explained by changes in homeostasis at cellular and individual levels. In the present study, an isoclonal population of *Daphnia magna* (clone k6) was exposed to an environmentally relevant concentration (5 µg/L) of carbendazim during different generations. The effects of carbendazim on survivorship, reproduction, parental length, DNA damage (determined by comet assay), biochemical biomarkers (cholinesterase, catalase and glutathione S-transferase), lipid peroxidation and energy-related parameters (carbohydrates, lipids and proteins jointly with energy available and energy consumption) were assessed in some generations. The long-term exposure to carbendazim presented no effect on the intrinsic rate of natural increase (r) and length of adult *D. magna*. However, daphnids longevity decreased at F12 generation and an increase in DNA damage from generation F3 to F13 was found when compared to daphnids in clean medium. Cholinesterases and glutathione S-transferase activities and lipid peroxidation showed differences between non-exposed and exposed populations to carbendazim. However, for catalase and energy-related parameters (except lipids) no differences were observed between these two *Daphnia* populations. Overall, at the tested concentration, carbendazim induced low effects under a long-term exposure to a daphnid population.

**WE001**

**Development of a modelling framework for estimating the sorption of pharmaceuticals in soils**

L. Carter, University of York / Environment Department; J. Wilkinson, The University of York / Natural and Built Environments; A. Bovall, University of York / Environment Department

Ionisable pharmaceuticals comprise a significant and increasing proportion of chemicals used in Europe. At typical environmental pH, ionisable pharmaceuticals can become charged. Speciation can alter the fate and behaviour of a chemical in the environment including its sorption potential to soils and sludge. It is essential that the behaviour is recognised within chemical risk assessment and predictive approaches are able to account for how speciation alters chemical sorption. Several authors have proposed approaches to predict the sorption of ionisable chemicals in soils. However, these models are typically based on training sets containing a multitudinous of organic chemicals and their ability to predict ionisable pharmaceutical sorption specifically needs to be evaluated. We therefore evaluated a range of predictive approaches, that take into account sorbent properties (i.e. soil characteristics), for their suitability for estimating sorption of pharmaceuticals in soil. The evaluations were done using a database of high quality experimentally-determined pharmaceutical sorption coefficients provided by industry partners. Models developed for specific classes of ionisable chemicals (i.e. cations or anions) performed better in comparison to simple generic models, which assume that hydrophobicity is the key sorption mechanism and neglect to take into account of the effects of chemical speciation. Nevertheless, model predictions for anionic pharmaceuticals still performed poorly (r² < 0.5). Sorption coefficients for organic cations were typically within an order of magnitude of experimental values whereas sorption was consistently lower than the sum of sorption to organic matter and to clay minerals. As sorption of neutral and anionic compounds were not well explained by the evaluated models, further model development was required for adequate prediction of soil sorption coefficients for these classes of molecule. A decision tree framework to guide the selection of appropriate sorption models by taking into account soil pH and ionisable functional groups has been created. This incorporates previously published models that performed well in our analysis and the development of new sorption models. Work is currently on-going to review sludge sorption models and will be presented. The authors acknowledge EU/EFPIA Innovative Medicines Initiative Joint Undertaking (iPIE grant no 115735) for the financial support.

**WE002**

**Photochemical transformation and intermediate formation processes in surface waters, in the context of climate change**

D. Vione, M. Minella, C. Minero, University of Torino / Chemistry

Sunlight illumination of surface waters induces several photochemical reactions that play an important role in the fate of organic compounds and of xenobiotics, in the inactivation of pathogens and in biogeochemical cycles. These processes involve both the direct photolysis of the target molecules (directly triggered by absorption of sunlight, if any), and their indirect or sensitised transformation. In the latter case, sunlight is absorbed by naturally-occurring photosensitisers (e.g. chromophoric dissolved organic matter or CDOM, nitrate and nitrite) that produce several intermediate species and trigger chemical transformation reactions. The transients include, among others, the hydroxyl (OH) and carbonate (CO³⁻) radicals, singlet oxygen (¹O₂) and CDOM triplet states (CDOM²⁺). Their occurrence in surface-water environments is linked to irradiance and to key water parameters such as chemistry and depth [1,2]. The photo-phototransformation of dissolved compounds involves an interplay between molecular photoactivity and environmental features. Water chemistry and depth can affect both xenobiotics persistence and the possible formation of toxic or mutagenic intermediates. If an hazardous compound is preferentially produced by a certain photo-reaction pathway, the environmental conditions can enable or inhibit its formation in different surface-water environments [3]. The role of climate change on water chemistry and, as a consequence, on photochemical reactions is just starting to be investigated. The main difficulty is to disentangle climate effects from other disturbance factors (e.g. wastewater inputs) that may also operate and vary on the long term [4]. Climate change has the potential to deeply alter the photochemistry of freshwater, but its effects could be very different in boreal vs. temperate environments. In the former case the main effects would involve water photolysis (browning), while in the latter case a role of photoreactions (browning, treeline shifts, extended drought periods) would play key roles depending on the context. [1] Vione D, Minella M, Maurino V, Minero C. 2014. Chemistry Eur. J. 20:10590-10606. [2] Rosario-Ortiz FL, Canoica S. 2016. Environ. Sci. Technol. 50:12532-12547. [3] Avetta P, Fabbri D, Minella M, Brigante M, Maurino V, Minero C, Pazzio M, Vione D. 2016. Water Res. 105:383-394 [4] Mineli L, Leoni B, Salmaso N, Savoye L, Sommaruga R, Vione D. 2016. Sci. Total. Environ. 541:247-256.

**WE003**

**How Pharmaceutical Industrial waste can make your medicines ineffective**

N. Verma, Baddi University of Emerging Sciences & Technology / Pharmacy

Spread over 380 square kilometres in Himachal Pradesh's Solan district, the Baddi-Barotiwala-Nagarh (BBN) industrial area is one of India’s largest pharmaceutical manufacturing hubs. The region hosts around 500 small, medium and large pharma units and accounts for 35 per cent of Asia’s total medicine production. But rapid industrialisation and a lax attitude towards safe disposal and management of pharma waste concerns about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipes and other outlets that open behind the plant or run underground and open into bushy areas. This released wastewater accumulates in or flows through nullahs, canals and rivulets into the Sirsa river. Effluents are also injected into the ground at night by digging bore wells or released during rains. Due to such practices, the BBN region is one of the most polluted areas in India due to high levels of antimicrobial resistance (AMR), a public health threat. The result of our study showed that all gaps leading to the release of...
APIs in the environment are plugged. The discharge of pharmaceutical effluents should take place through proper waste management techniques and stringent environmental regulations. Currently, effluent standards are limited to chemical contaminants such as heavy metals. The government must adopt a new AMR-centric approach of waste management which considers APIs as a chemical contaminant. Laws must be made to ensure that there are no APIs in treated effluents. The government should support small-scale manufacturers to install and implement environmentally sound waste treatment and disposal techniques. Manufacturers with high-end WWTPs should also be strictly monitored. The SPCBs should conduct surveillance of APIs or antibiotic residues in the treated effluents and make data publicly available.

**WE004**
The environmental concentration and evaluation of active ingredients in pharmaceuticals in rivers flowing through urban area in Japan

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The active ingredients in pharmaceuticals are discharged into the aquatic environment after use mainly through sewage treatment facilities. There is concern about adverse effects on wildlife due to the possibility of the presence of highly susceptible species. However, we still know little about what kind of impact on wildlife in the environment. Based on these backgrounds, we set up environmental impact assessment methods for the pharmaceuticals according to AMED’s strategy and evaluated the risks. We have measured the environmental concentrations (MEC) of 31 kinds of active ingredients in marketing medicine, using liquid-chromatography with mass spectrometry, in representative seven urban rivers in Japan, once every four seasons in 2015-2016. The maximum detected concentrations of the active ingredients exceeded 100ng/L are shown below: olmesartan (571ng/L), valsartan (445ng/L), lanbesartan (117ng/L), ketoprofen (150ng/L) for antihypertensive agent, and sulpiride (546ng/L) for antipsychotic agent, clarythromycin (445ng/L) for antibiotic agent, ketoprofen (150ng/L) for analgesic antipyretic agent, bezafibrate (200ng/L) for hyperlipidemia treatment drug, crotamiton (845ng/L) for antipruritic agent. Among target ingredients, the detect concentration of active ingredient contained in pharmaceuticals for the lifestyle-related disease, hypertension and lipid metabolism related disease, tended to be higher. The concentrations in the winter or spring was observed a higher tendency, but the detected concentrations of active ingredients greatly varied depend on river according to the type of lifestyle and the type of pharmaceuticals been spread. It was indicated that the detected active ingredients were derived mainly from sewage treatment water as it depends on the concentrations of sucralose measured at the same time. The pharmaceuticals whose maximum detected concentrations of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of candesartan, olmesartan, lorzepam, rosuvastatin and epinastine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider the contribution of dilution from the urban environment which sets it. Regarding the health effects on humans, the actual concentration for each daily minimum dose for each pharmaceutical ingredient was from 0.086% of lorzepam to 0.000001% of chloridic acid.

**WE005**
Evaluating of simple exposure models used for environmental prioritisation of active pharmaceutical ingredients

J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, L. Carter, University of York / Environment Department; E. Burns, University of York

Targeted quantification using analytical methods such as high performance liquid chromatography followed by tandem mass spectrometry (HPLC-MS/MS) are effectively used to monitor trace-levels (ng/L) of active pharmaceutical ingredients (API) in the aquatic environment. However, as more than 1500 chemicals are currently in-use as pharmaceuticals, the high cost of HPLC-MS/MS prohibits its widespread use in the monitoring and prioritisation of APIs. Predictive exposure models allow easier threat assessment and/or cost-effective and rapid API quantification. Predictive models are not without limitations and their assumptions and defaults are, at times, not representative of actual environmental conditions. Here we evaluate the accuracy of simple exposure models used to generate predicted environmental API concentrations (PECs) and their suitability for prioritisation of APIs in the aquatic environment. Water samples (n=60) were collected in triplicate from six-months both upstream and downstream from five wastewater treatment plants (WWTPs) discharging into four rivers in the UK. Measured environmental concentrations (MEC-values) of 33 APIs were determined by HPLC-MS/MS. PEC-values were determined using pharmaceutical use data from the National Health Service, the fractions of chemical excreted from the body and degraded during sewage treatment, the population equivalence of each WWTP, mean regional per-capita water use and the dilution ratio of treated sewage effluent in receiving rivers. API-specific PEC ranges were compared to complementary MEC ranges observed over the 6-month sampling campaign and PEC:MEC ratios were determined. PEC:MEC ratios were generally low (< 0.5), indicating that predicted API concentrations were lower than measured. Between rivers, PEC:MEC ratios were generally closest to measured values in the lowest flow (smallest) rivers and in stretches near the headwaters indicating that locations with minimal upstream contributions of sewage effluent produced the most accurate PECs. In terms of prioritisation, predicted concentrations successfully identified eight of the ten APIs measured at highest concentrations among all 5 study locations (metformin, gabapentin, atenolol, desvenflukoxamine, fenofibrate, clofibric acid and paracetamol). PECs may be best used for prioritisation over use in more sensitive applications, such as risk assessment, as PECs were consistently shown to underestimate API concentrations.

**WE006**
The role of the water-sediment simulation test and its outcome in the environmental risk assessment (ERA) of pharmaceuticals

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In view of the revision of the “Guideline on the environmental risk assessment of medicinal products for human use” (EMEA/CHMP/SWP/447/00, June 2006, rev. 2) current fate assessment is highly discussed concerning the water-sediment simulation test in tier A of the guideline. At the moment, only the partitioning to sediment triggers further assessment in the next tier of the guideline. Derived half lives were not used in refined predicted exposure concentration (PEC) calculations and transformation products (TP) were not specifically considered in the ERA. Now, UBA evaluates the data received in the last 10 years in order to determine the gaps and the benefit of the current fate assessment for the overall risk assessment e.g. classification of persistence. Especially the role of TP in the environment due to their frequent higher mobility compared to the parent compound is considered in the presented research. As a first step an overview is prepared on the overall persistence of pharmaceuticals in water in the four study locations. It is clearly demonstrated that total system half-lives already show a high persistence of pharmaceuticals in the aquatic environment. Furthermore it should be considered that especially for the sediment compartment often no kinetic model fits well enough to predict DT50 values. The risk of ground water contamination by bank filtration will be estimated by that applying chemical characteristics e.g. lipophilicity / hydrophilicity by comparing parent compound and TP. The occurrence and identification of TP is often appeared to be something which is only “nice to have” but not really relevant for the risk assessment of human pharmaceuticals. TP are often more polar and stable in environmental compartments than the parent compounds. This is of high relevance for groundwater contamination. The identification of relevant TP is still often missing in provided studies. The water sediment simulation study is the only experimental study in the ERA which gives information about the possible behaviour and occurrence of parent compounds and TP in surface waters. Such results are relevant for monitoring and for the understanding which compartments are affected by pharmaceuticals. Instead of waiving OECD 308, the results should be better included in the ERA and communicated.
background was used to support that decision and what data, modelling approaches and assumptions were used in addition to the sources of data. Preliminary analysis of those compounds for which empirical fish BCF data are available in the literature against our new strategy revealed that if our strategy was followed in at least 19% of these cases an empirical study would have not been required.

WE008
Development of a quantitative Adverse Outcome Pathway-informed model to predict the risk posed by mixtures of non-steroidal anti-inflammatory drugs to fish
P. Marmon, J. Kayode, Brunel University London / College of Life Sciences; S. Owen, AstraZeneca / Safety Health Environment; L. Margiotta-Casaluci, Brunel University London / Institute of Environment, Health and Societies

The presence of low concentrations of non-steroidal anti-inflammatory drugs (NSAIDs) in the aquatic environment has raised the concern that chronic exposure to these compounds may cause adverse effects in wild fish populations, similar to those observed in human patients. This potential scenario has led to the inclusion of diclofenac in the European Union Watch List of emerging pollutants. Although the effects of diclofenac in fish have been investigated in over twenty published studies to date, the complexity of NSAIDs toxicity is such that many uncertainties still exist about the significance of those findings for environmental risk assessment. We hypothesise that the perturbation of cyclooxygenase (COX) activity in healthy fish tissues is the leading cause of adverse effects, as it is in humans. On the basis of this mechanistic starting point, we propose a quantitative Adverse Outcome Pathway-informed approach to estimate the chemical and pharmacodynamic aspects of NSAIDs toxicity. After extracting all NSAIDs toxicity data available in the scientific literature, we applied drug uptake models to predict the plasma concentrations at which different effects would occur in laboratory studies. As all NSAIDs act by inhibiting the enzymes COX1 and/or COX2, we applied mixture pharmacology approaches to express the plasma effect concentrations (PECs) and effect quotients (EQs) as direct concentrations and used this approach to express the plasma concentrations of NSAIDs that are used to predict plasma concentrations of NSAIDs in wild fish. The overlay of the two approaches led to a visual model that enables a rapid assessment of the risk posed by environmental levels of NSAIDs to trigger multi-scale adverse effects. The major strength of the model is the ability of a direct relationship between the potential of NSAIDs mixtures, expressed as diclofenac-equivalents. We propose that this mechanistic approach may provide a useful predictive tool to support the implementation of effective NSAIDs eco Pharmacovigilance strategies and facilitate the regulatory interpretation of past and future toxicity data.

WE009
Evolution in the lab - How can we study the chronic exposure to pharmaceuticals over multiple generations?
K. Heye, Goethe University Frankfurt/ Main / Aquatic Toxicology; A. Schmidt, Goethe University Frankfurt / Aquatic Ecotoxicology; J. Oehlmann, Johann Wolfgang Goethe-Universität Frankfurt / Aquatic Ecotoxicology

Lethal experiments conducted with zebrafish embryos showed a chiral resolved nature of antidepressants like CBZ. To answer this question, the non-biting midge Chironomus riparius was chosen as a test organism for a multi-generation experiment. 2400 chironomid larvae (<24 h old) were taken from a laboratory culture to set up two exposure cages – one where larvae were continuously exposed to the LC50 of CBZ (0.4 mg/L, nominal concentration) and one control. When we were sure that a new generation had started, egg clutches were taken out of the cages to set up two chronic toxicity tests. Lethal and effect concentrations of mortality and mean time to emergence were calculated using a non-linear regression model (logistic curve). Sensitivity was compared by looking at overlaps of the CI (0.506 to 0.882 mg/L for the control and 0.729 to 1.1 mg/L for the pre-exposed group). Four months later, sensitivity was compared again. LC50 of the pre-exposed group was higher than in the control, with no overlap of the CI (0.668 to 1.02 mg/L for the control and 1.08 to 1.96 mg/L for the pre-exposed group). After two and six months, control mortality of both groups was low and emergence in the cage stayed constant. Multi-generation experiments are a helpful tool to investigate long-term effects of chemicals on aquatic organisms. Within the first six months of the ongoing study, midges showed to be less sensitive to carbamazine after long-term low-level exposure. Chronic toxicity tests to study the authors sensitivity of exposure groups should be combined with genome and transcriptome analyses to get a full picture of adaptation processes in midges. Acknowledgement - The authors thank the Federal Ministry of Education and Research (BMBF) for funding (NiddaMan, project support contact: 02WRM1367A).

Effects of duloxetine and econazole on freshwater species towards individual and combined conditions
G. AMARIEL, Universidad de Alcalá; K. Boltes, University of Alcalá / Chemical Engineering; J. Valimála-Traverso, M. García, P. Letón, M. Marina, R. Rosal, University of Alcalá

Thousands of biologically active pharmaceutical ingredients (APIs) are used in human and veterinary medicine worldwide. Nowadays, the occurrence of pharmaceuticals in aquatic environments is a well-established issue, there are still gaps in our knowledge on the fate and effects of these compounds in the environment. Evaluating API ecotoxicology is even more challenging due to uncertainties about appropriate dosages, durations of exposure, range of sensitive taxa, sensitivity of developmental stages, and toxicological endpoints. More attention should be paid on the non-target organisms and the chiral nature of contaminants. This work assess the toxicity of the antidepressant drug Duloxetine and the antifungal Econazole, individually and combined, on three freshwater species—algae, crustacean and duckweed, using APIs concentration from 0.039 to 10 mg L−1. Level an type of drugs interactions were determined using the Combination Index-isobologram method. The enantiomers concentration of the target compounds in the culture media were (9R,10S)−EC and (R,R)−DO. To analyze the relationship between degradation profile and the observed toxicity on organisms. Results reveal toxic effects of Duloxetine and Econazole leading to growth reduction and significant changes in the morphology of duckweed fronds. The EC50 values obtained showed Duloxetine as very toxic for algae and toxic for crustacean and plants. Econazole appears as very toxic for all species evaluated. Mixed toxicity profiles (OBIRs) for trout treated antidepressants (TCAs) are now on market worldwide. It is possible to measure the concentrations of selected antidepressants by chemical analysis, but such concentrations do not indicate the physiological activity of antidepressants in waters. For example, even if the concentration of each substance is low, through additivity compounds might produce a strong enough physiological activity to harm aquatic organisms. To determine whether antidepressant drugs interact to each other through these mechanisms, we must know the extent to which such organisms may be exposed to antidepressants as determined by the inhibition of monoamine transporters. In this study, we measured the physiological activity of antidepressants in WWTP effluents for the first time by the in vitro assay (namely called antidepressant assay). We utilized fluorescence substrate, APP, for monoamine transporters (serotonin transporters (SERT), norepinephrine transporter (NET), and dopamine transporter (DAT)). By transfecting a plasmid expressing transporter into cultured cell line, and measuring the fluorescence intensity inside the transfected cells, inhibitory activity of antidepressant on the uptake of APP by transporter could be quantified. We applied the antidepressant assay to secondary effluents (SEs) of WWTPs in Japan, and succeeded to detect the inhibitory activity of antidepressants in SEs. Inhibition was detected in SERT or NET-expressing cells, but not in DAT-expressing cells, suggesting that detected inhibitory activity come from SSRIs, SNRIs, and/or TCAs, not DRIs in SEs. Activities detected in SEs could be quantified as antidepressant-equivalent quantities (EQs). By comparing EQ values with the effective concentrations of antidepressants in vivo behavior testing, we can know whether antidepressants in environmental water is really risky to aquatic organisms.

WE010
Toxicology of pharmaceuticals to aquatic organisms: a meta-analysis of effects on development and reproduction
V. F. Fonseca, I.A. Duarte, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; B.M. Gillanders, School of Biological Sciences, The University of Adelaide / Southern Seas Ecology Laboratories; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre

We used a meta-analysis to study the chronic exposure to pharmaceuticals over multiple generations. To study the chronic exposure to pharmaceuticals over multiple generations. To study the chronic exposure to pharmaceuticals over multiple generations.
The ubiquity of pharmaceutical compounds in the aquatic environment, their growing use and their potential to elicit biological effects even at low concentrations is a major concern to environmental health and safety management. In recent years an increasing number of studies have addressed the presence and toxicity of various pharmaceuticals, using various biological endpoints in different biological models, and reporting varying effects. Accordingly, a systematic quantitative assessment is key to improve current understanding of the ecological risks of pharmaceutical compounds in aquatic environments. To unravel patterns in biological responses across aquatic taxa a meta-analysis was performed on reported effects of exposure to pharmaceutical compounds (according to therapeutic class). Minimum response concentration and biological responses were collected from selected studies based on a set of objective criteria. Considering organisms’ exposure to pharmaceuticals under controlled conditions. For a response sensitivity analysis various endpoints were considered, namely biochemical, developmental (e.g. growth), reproductive and behavioral responses, as well as lethality, in studies reporting effects on aquatic taxa. The comparative sensitivity analysis of biological endpoints highlighted the sensitivity of molecular responses, followed by individual level-responses (e.g. behavior and growth), yet variable sensitivity among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitative analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

WE013 Leveraging Pharmacological Data for Prioritization of the Ecological Risks of Chiral Pharmaceuticals

E. Unganayiword, Shantou University / Marine Biology Institute; J. Gan, University of California, Riverside / Department of Environmental Sciences

Pharmaceuticals are frequently detected in wastewater and the environment at concentrations ranging from ng/L to µg/L. More than 50 % pharmaceuticals are chiral compounds. Enantiomers of chiral pharmaceuticals have been shown to exhibit differences in environmental fate, transport and toxicity. Since more than 2,500 pharmaceuticals are currently in use, it is implausible to carry out whole organism toxicity studies of all pharmaceuticals. However, there is a wealth of knowledge available from drug discovery and development research that can be leveraged for predicting potential environmental exposure and effects of chiral pharmaceuticals. Assuming evolutionary conservation of primary drug target, read-across method can be used to predict the potential effect of chiral pharmaceuticals. In this study, we estimated the stereoselective effect of 11 chiral pharmaceuticals using the fish plasma model. We found metoprolol had high risk with an effect ratio, ER (ratio of human therapeutic plasma concentration to fish plasma concentration at steady state) that was less than 1.0, whereas propranolol, salbutamol, fluoxetine and venlafaxine were medium risk (1.0 < ER < 30). However, stereoselectivity was predicted in all compounds except atenolol and pindolol. In this study, we showed the fish plasma model has considerable potential for predicting stereoselective toxicity of chiral pharmaceuticals.

WE014 Effects of benzoylgenine exposure at different levels of the biological hierarchy on Daphnia magna

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A number of monitoring studies have shown that benzoylgenine (BE), a metabolite of cocaine, is the main illicit drug residue measured in both wastewater and surface waters worldwide. Although the aquatic concentration of BE can be considered still low, the exposure to this molecule may cause diverse adverse effects. In this study, we investigated the toxicity of this molecule towards invertebrate and vertebrate aquatic non-target organisms have shown different detrimental effects at low levels of the biological organization, mainly at biochemical, molecular and cellular levels. However, to date no one study has evaluated the consequences of BE exposure to the higher levels of ecological hierarchy. Thus, the present study was aimed at investigating the toxicity of a 48-h exposure to different concentrations of BE, simulating those found in aquatic ecosystems (0.5 µg/L and 1.0 µg/L), on the cladoceran Daphnia magna at different levels of the ecological hierarchy. We relied on a multi-level approach focusing on the effects at biochemical/biomolecular (biomarkers), individual (swimming activity) and population (reproduction) levels. As previous studies of BE have shown that this molecule can induce oxidative stress, we assessed the amount of reactive oxygen species and of the activity of antioxidant (SOD, CAT, and GPX) and detoxifying (GST) enzymes and the lipid peroxidation (TBARS) as oxidative stress endpoints. We also measured the acetylcholinesterase (AChE) activity because this enzyme is strictly related to behavioral changes in aquatic organisms. Alterations in the swimming behaviour of D. magna were investigated by a video tracking analysis, while the consequences on the reproduction were assessed by a chronic toxicity test. Our results showed that the exposure to two BE concentrations similar to those found in aquatic ecosystems induced oxidative stress and inhibited the activity of AChE, affecting the swimming behavior and the reproduction of Daphnia magna individuals.

WE015 Impact of the antibiotic drug metformin and its transformation product guany lurea on brown trout (Salmo trutta f. fario)

J. S. Jacob, Universität Tübingen / Animal Physiological Ecology; L. Kundy, M. Biecker, University of Tuebingen; R. Triebkorn, University of Tuebingen / Animal Physiological Ecology

The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antibiotic drugs as metformin (MF) has become obvious. In wastewater treatment plants, metformin is only partially retained and also transformed to guany lurea (GU) leading to high concentrations of both compounds in surface waters. However, possible effects of MF and GU in aquatic organisms are far from being understood. The aim of this study is therefore to investigate influences of MF and GU on different metabolic pathways and behaviour in different life stages of brown trout (Salmo trutta f. fario). Juvenile trout (age: 8 month) were exposed for 4 weeks at 7°C to different concentrations of MF (0, 10, 1000 µg/L) and GU (0, 10, 100, 1000 µg/L). Additionally, eggs of brown trout in the eyed ova stage were exposed to different metformin concentrations (0, 1, 10, 100, 1000 µL) at 7°C & 11°C (regarding possible interactions of chemical toxicity & temperature). To show influences on the embryo development, mortality, hatching rate, and heart rate were recorded. Tissue samples were taken three and eight weeks after the end of the sac-fry stage. In all experiments, several endpoints characterizing fish health were investigated, including the histological condition of the liver, alterations in the stress protein level (heat shock), changes in the intestinal microbiome and additionally the glycogen storage in the liver of MF-exposed fish. Besides, swimming and predator-prey behaviour were investigated. There was no influence of MF on the developmental parameters in brown trout larvae. Neither behaviour nor stress protein level were influenced by MF. The liver tissue of the MF-exposed trout was in a good condition. The glycogen storage was tendentially increasing in MF-exposed fish compared to the control, whereas the glycogen content of the trout exposed to 1000 µg/L MF was partially decreased. The intestinal microbiome of MF-exposed larvae showed a significantly different composition compared to the control. The results for the experiment with GU will be presented (analyses not yet finished). This work is part of the project Eff-Net (Effect Network in Water Research) funded by the Wassernetzwerk Baden-Württemberg.

WE016 Effect of life-cycle exposure to environmentally relevant concentrations of metformin and its metabolite guany lurea on F1 progeny 28 days post hatch

Z.P. Pandelides, University of Ontario Institute of Technology; E. Ussey, University of Ontario Institute of Technology / Biological Sciences; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science Aquatic Toxicology; Z.P. Pandelides, University of Ontario Institute of Technology; J. Guchardi, University of Ontario Institute of Technology / Science Aquatic Toxicology

In recent years an increasing number of studies have addressed the presence and environmental concentrations of MF (0, 1, 10, 100, 1000 µg/L) and GU (0, 10, 100, 1000 µg/L). Additionally, eggs of brown trout in the eyed ova stage were exposed to different metformin concentrations (0, 1, 10, 100, 1000 µL) at 7°C & 11°C (regarding possible interactions of chemical toxicity & temperature). To show influences on the embryo development, mortality, hatching rate, and heart rate were recorded. Tissue samples were taken three and eight weeks after the end of the sac-fry stage. In all experiments, several endpoints characterizing fish health were investigated, including the histological condition of the liver, alterations in the stress protein level (heat shock), changes in the intestinal microbiome and additionally the glycogen storage in the liver of MF-exposed fish. Besides, swimming and predator-prey behaviour were investigated. There was no influence of MF on the developmental parameters in brown trout larvae. Neither behaviour nor stress protein level were influenced by MF. The liver tissue of the MF-exposed trout was in a good condition. The glycogen storage was tendentially increasing in MF-exposed fish compared to the control, whereas the glycogen content of the trout exposed to 1000 µg/L MF was partially decreased. The intestinal microbiome of MF-exposed larvae showed a significantly different composition compared to the control. The results for the experiment with GU will be presented (analyses not yet finished). This work is part of the project Eff-Net (Effect Network in Water Research) funded by the Wassernetzwerk Baden-Württemberg.

WE017 Life-cycle effects in Oryzias latipes exposed to environmentally relevant concentrations of metformin and its metabolite, guany lurea

E. Ussey, University of Ontario Institute of Technology / Biological Sciences; Z.P. Pandelides, University of Ontario Institute of Technology; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science Aquatic Toxicology

One of the most common contaminants in the aquatic environment is the type 2 diabetic drug metformin. Metformin has been measured in the ng-µg/L concentration range in both German and North American surface waters and wastewater effluent. As the majority (>90%) of metformin is metabolized into...
exposure to environmentally relevant concentrations of metformin (1.0-100 µg/L) and guanylurea (1.0-100 ng/L) from embryo through 28 days post hatch have a significant decrease in length (mm) and weight (mg) of both males and females in comparison to control fish, with guanylurea appearing to be roughly 1,000 times more potent than its parent compound, metformin.

Furthermore, these studies show significant changes in the metabolome of 28 day old male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. These results raised concern regarding the consequences of a full life cycle exposure, including the important reproductive phase. Thus, a full life-cycle continuous exposure experiment was undertaken utilizing both compounds at environmentally relevant concentrations, alone and in combination, was conducted in order to examine the effects of chronic exposure on growth, reproduction, steroid production, and gene expression. Results will be discussed.

WE018 Environmental Fate and Effects of the Antidiabetic Drug Metformin and Its Transformation Product Guanylurea
J. Straub, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environment Health Safety Sustainability; V. D’Acco, Quantum Management Group, Inc.; T. Davidson, Boston Biomedical Research Institute / Biomedical Research Institute; B. De Felice, Bristol-Myers Squibb AstraZeneca / Safety Health Environment; B. Simon, J. Straub, F. Hoffmann-La Roche Ltd / Group SHE

Metformin (MET) is an active pharmaceutical ingredient (API) with very high patient use worldwide that is excreted in unchanged form. This has led to concerns about the potential aquatic life impacts associated with the presence of MET in surface waters. For the guanylurea (GUU) transformation product, both MET and GUU are further degraded in the environment. A comprehensive aquatic life risk assessment of MET and GUU in surface water is presented that is based on literature data, previously unpublished data from industry studies conducted to support new drug registration applications as well as new studies commissioned to fill data gaps. Predicted environmental concentrations (PECs) for MET were modelled based on documented usage for the USA with the PhATE model and for the European Union with the GREAT-ER model. These PECs were compared with measured environmental concentrations (MECs) for both the USA and EU. A predicted no effect concentration (PNEC) for MET was derived by deterministic procedures based on multiple chronic studies with algae (4), daphnids (5) and fish (5, two species). Both the PEC/PNEC and MEC/PNEC risk characterization ratios were well below 1, indicating no significant risk for MET with high margins of Safety. However, since MET is known to be primarily degraded during wastewater treatment to GUU, relevant chronic studies for GUU were conducted to derive a PNEC. In addition, PECs were derived for GUU for the USA and EU as above for MET. Fate and removal/in-stream-loss parameters for both MET and GUU show alignment to PECs at JUPECS in the USA and Europe. The PEC/PNEC and MEC/PNEC risk characterization ratios for GUU were also well below 1. We conclude there is no significant risk to aquatic life for both MET and its transformation product GUU.

ZE019 Fluoxetine exposure modulated antioxidant and anxiety-related gene expression altering swimming activity in zebrafish embryos
B. De Felice, Università degli Studi di Milano; A. Ghilardi, L. Del Giacco, University of Milan; M. Parolini, University of Milan / Department of Environmental Science and Policy

The massive release of human pharmaceuticals into the aquatic ecosystems continues to be a serious environmental problem. Aromatic pharmaceuticals, psychotropic drugs such as antidepressants are one of the main therapeutic classes detected in freshwater worldwide. Selective serotonin reuptake inhibitors (SSRIs) are commonly the first-line antidepressants prescribed to alleviate anxiety disorders in humans, and fluoxetine (FLX), the active principle of the antidepressant Prozac, is one of the most widely used SSRIs worldwide. FLX enters aquatic ecosystems, whereby it has been detected in the high ng/L to low µg/L concentration range. Although many studies have demonstrated that the exposure to FLX caused a plethora of adverse effects in aquatic species, the information regarding its molecular mechanisms of action and the relationship with organism behavior remains scant. Thus, the present study was aimed at investigating 1) the effects induced by two concentrations of FLX (50 ng/mL and 500 ng/mL) on the expression of genes related to oxidative stress response (sod1, sod2, cat, gpx and gsr), stress and anxiety (ostx; plt2, npy and ucn3); as well as transporters of main neurotransmitters (slc6a3, slc6a4a, slc6a4b, slc6a11) and 2) if changes in the expression of neurotoxicity-related genes was related to changes in the swimming behavior of zebrafish (Danio rerio) embryos at 96 hours post fertilization (hpf). Our results showed that FLX exposure overexpressed sod1, cat and gxs, suggesting that this drug can induce an overproduction of pro-oxidant molecules. In addition, changes in the expression of slc6a4b, slc6a4b and slc6a11 genes indicated that FLX can affect neurotransmission and, consequently, alter swimming behavior of embryos, as demonstrated by the significant reduction of the distance moved by treated embryos in response to an external stimulus.

WE020 Bio-Optical probing of Beazafibrate toxicity in model marine diatom Phaeodactylum tricornutum
B. Duarte, MARÉ Marine and Environmental Sciences Centre / Centro de Oceanografia; A. Matos, BioSILBiosystems and Integrative Sciences Institute / Plant Functional Genomics Group; T. Cabrita, IPMA IP; J.C. Marques, University of Coimbra / MARÉ, Dep. of Life Sciences, Coimbra University; I. Caçador, Faculdade de Ciências da Universidade de Lisboa / MARÉ - Marine and Environmental Sciences Centre; P. Reis-Santos, MARÉ - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARÉ-FCUL; V.F. Fonseca, MARÉ Marine and Environmental Sciences Centre

The occurrence and fate of pharmaceutical active compounds in aquatic environments has become a major cause for concern due to their effects on humans and aquatic ecosystems. The high consumption of blood lipid regulators is leading to increased occurrence of fibrates in natural streams and wastewater effluents. Fibrates are a class of drugs derived from fibrin acid widely used to reduce plasma triglycerides and raise the level of high-density lipoprotein cholesterol. Specifically, Beazafibrate is extensively used as a lipid regulator with consumption greatly increasing over the years in developed countries. Due to its large use and its persistence, beazafibrate has been detected in surface and drinking waters as well as in wastewater effluents. This can have serious effects on marine life, on marine primary producers and thus impacting the whole system productivity and functioning. Exposing the model diatom Phaeodactylum tricornutum to a range of environmentally relevant concentrations of beazafibrate (0-60 mg/L) revealed no serious impacts on cell growth. Nevertheless, after 48h of exposure damages in the photosynthetic apparatus were detected using bio-physical probing Pulse Amplitude Modulated (PAM) Fluorometer. Beazafibrate exposure induced two photosystems, which reduced the algal ability to harvest photonic light and convert it into an electron flow, and thus its chemical energy production (ATP). This may result from a direct effect of beazafibrate in membrane fatty acids from the chloroplast, since both photosystems are anchored in a lipidic membrane system. Moreover triglycerides (TAGs) are known to protect the photosystems against photoinhibition. The reduction of TAGs could lead to burnout of the photosystems due to excessive energy being absorbed, as observed by the high incoming photonic energy flux, which way reducing the number of active reaction centers in the algae and thus its photosynthetic ability. All these bio-physical parameters show a clear dose-effect relationship, indicating that P. tricornutum is a good candidate organism for beazafibrate testing in marine systems, screened by non-invasive high-throughput bio-physical probing tools.

WE021 Environmental Risk Assessment for the Active Pharmaceutical Ingredient Mycofenolic Acid in European Surface Waters
J. Straub, F. Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; A. Haener, F. Hoffmann-La Roche Ltd / Group SHE

An Environmental Risk Assessment (ERA) was performed for the active pharmaceutical ingredient mycofenolic acid (MPA) for Europe. MPA is an older immune inhibitor developed in the USA in the 1990s by Syntex, Inc., now a part of the Roche Group. So far, no sufficient dataset describing biodegradability, environmental fate or ecotoxicity for MPA nor an ERA for MPA have been available. The present ERA is based on old environmental data from Syntex and on new tests, all performed under GLP quality assurance, for physico-chemical characteristics, partitioning, environmental fate, biodegradability and (sub)chronic/acute toxicity and on sales amounts for the products containing MPA in Europe. Both a new biodegradation study and an older sediment/water test show that MPA is not recalcitrant but undergoes primary up to (sub)chronic degradation in wastewater treatment and surface water models. A predicted environmental concentration (PEC) in Europe from all products containing MPA was calculated based on compound actual use data from IMS Health, Inc. per annum and country, incorporating population data from Eurostat, for the decade 2004–2014. A crude initial PEC was derived based on standard ERA assumptions of no removal in sewage treatment or surface waters. The crude PEC was refined by incorporating predicted sewage works removal, based on new biodegradability data, and by country-specific dilution factors. The lowest of the no observed effect concentrations from chronic and subchronic tests with algae, daphnia and fish was divided by an assessment factor of 10 to derive the chronic no observed effect concentration (PNEC). Potential risk for surface waters was then quantified by dividing the PECs by the PNEC. Potential risk from MPA was also assessed for sewage works and bacterial populations. In addition, MPA is not expected to bioaccumulate nor to adsorb to sewage sludge or to sediment to a significant extent. Conclusions on potential risks of MPA are given in the poster.

WE022 Cystostatics in Dutch surface water - overview of use and potential risks to the aquatic environment

SETAC Europe 28th Annual Meeting Abstract Book
After use, pharmaceuticals and their residues eventually end up in the sewage system. Sewage treatment plants reduce the nutrient load of waste water, and while organic micropollutant removal occurs concomitantly by bacterial activity and sorption to many contaminants, including pharmaceuticals, and some partially or partly are not removed. Consequently, effluent containing pharmaceuticals and their residues is discharged into surface waters. A recent study showed that 29 of 80 monitored pharmaceuticals were regularly detected in Dutch surface water, and that five of these substances, i.e. the pain killer diclofenac, the antibiotics azithromycin, clarithromycin and sulfasalazine, also turned up in the surface water of the Dutch coast, which forms part of the Wadden Sea ecosystem (Moermond et al., 2016). This raises concern, perhaps even more so when considering that for many of the around 2000 pharmaceuticals that were authorized for the Dutch market in 2016, it remains unknown to what extent they are present in surface waters, how they behave in the environment, and to what extent they exert toxicity to aquatic species individually and jointly. A class of pharmaceuticals that has received increased attention in the Netherlands, but also in the EU, e.g. PHARMAS project and Cytothreat, are cytostatics. These potent substances are used to inhibit cell division in cancer patients, but the fraction released unchanged to surface water could affect aquatic species in a similar manner. This project aimed to provide an overview of the use of cytostatics in the Netherlands and to determine if cytostatics pose a potential risk to the aquatic end of aquatic risk assessment. For this purpose, we monitored pharmaceuticals in the Dutch surface waters, how they behave in the environment, and to what extent they exert toxicity to aquatic species individually and jointly. An evaluation of the environmental concentrations of these pharmaceuticals in Dutch surface water was performed. The results showed that for approximately 2/3 of investigated APIs, valid effect studies on all three trophic levels were available

WE023 Environmental risk assessment of human pharmaceuticals - what can we learn from regulatory effect data so far?

S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; J. Bachmann, German Environment Agency (UBA) / Section IV 2.2 Environmental Risk Assessment of Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals

Since the coming into force of the guideline on the environmental risk assessment of medicinal products for human use (EMEA/CHMP/SWP/44470/00 corr 2), the German Environment Agency (UBA) is tasked with environmental risk assessment of human pharmaceuticals. Applicants seeking approval of medicinal products need to submit fate and effect data, in case predicted environmental concentrations exceed 10 µg/L in surface waters, or the substance is of specific concern through its mode of action. For approximately 2/3 of investigated APIs, valid effect studies on all three trophic levels were available – allowing a comparison of sensitivity. In over 60 % of cases, the effect value quotient of most and least sensitive test organism was greater than 10, in over 20 % of cases greater than 100. Fish were the most sensitive test organism in more than half of the cases, while algae and crustaceans were the most sensitive in one quarter, each. Detailed information concerning specific pharmaceutical groups/mode of actions will be given in the final poster. Our results will help to identify possibilities and limitations of the current regulatory approach, and provide information for future modifications of the regulatory framework.

WE024 Prioritisation of human pharmaceutical substances - a regulatory perspective

I. Rönnefahrt, German Environment Agency - UBA / Section IV 2.2 Pharmaceuticals, A. Hein, S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; A. Hein, S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; K. Westphal-Settele, German Environment Agency (UBA) / Section IV 2.2 Pharmaceuticals; I. Ebert, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals

Pharmaceuticals in the environment have been recognized by the European Commission as emerging issue. Possible actions to reduce their emission into the environment and the need for amendments of the legislation are currently discussed in the ‘strategic approach to pharmaceuticals in the environment’. At the German market, there are currently about 2300 active pharmaceutical substances used in human medicinal products; at least 1200 of them are compounds of potential environmental concern. For the majority of these 1200 compounds data for an environmental risk assessment (ERA) are incomplete or lacking, with the result that their potential environmental impact cannot be assessed in an appropriate manner. The reason for this is simple: So called ‘legacy products’ have been authorised before the ‘Guideline on the environmental risk assessment of medicinal products for human use’ came into effect in 2006. According to the current legislation, all these compounds are exempted from further investigation when there is scientific proof that it is a natural substance. A case study in the EU veterinary medicines marketing authorisation procedure T. Hahn, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment; C. Floeter, HAW Hamburg / Department of Environmental Engineering; S. Schwonbeck, G. Koennecker, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment.

The marketing authorisation process for veterinary pharmaceuticals in the EU and other countries requires an environmental impact assessment (EIA) for each veterinary medicinal product (VMP). This EIA follows a phased approach with conservative estimates of environmental exposure in phase I, which may later require refinement by experimental data in phase II. Core of the phase I assessment is a catalogue of 19 questions on use and characteristics of the VMP under consultation. These questions aim at establishing an initial predicted environmental concentration, which, together with information on therapeutic use and targeted animal species, needs to be evaluated for further assessment. The phase II assessment. According to question 2 in the phase I assessment a substance is exempted from further investigation when there is scientific proof that it is a natural substance “the use of which will not alter the concentration or distribution in the environment”. At first sight this definition appears unambiguous. Nevertheless may it be a hurdle for applicants because no further guidance is given which criteria apply for acceptance or rejection of a given concentration as ‘natural’. Here, we present a case study comprising two substances in order to highlight possible uncertainties for applicant companies, as well as for competent authorities.

Obesogens and lipid disruptors (P)

WE027 Unraveling distinct pathways of PFOS toxicity by combining morphological, metabolomic and transcriptomic analyses

R. López, Institute of Environmental Assessment and Water Research (IDAEA-CSIC) / Environmental Toxicology; L. Navarro-Martín, C. Lucarelli, IDAEA-CSIC; E. Ortiz, IDAEA-CSIC / Department of Environmental Chemistry; A.E. Codina, CNAG, D. Raldua, IDAEA-CSIC; C. Barata, CSIC / Environmental Chemistry; B. Pina, IDAEA-CSIC / Department of Environmental Chemistry; R. Tauler, IDAEA-CSIC / Environmental Chemistry

Exposure to PFOS (perfluorooctyl sulfonate) has been related to toxic effects on lipid metabolism, immunological response, and different endocrine systems. We present here a combined metabolomic and transcriptomic analysis of zebrafish embryos exposed to different concentrations of PFOS (30-1000 µg/L) from 48h to 120h. While parallel morphological analysis showed no macroscopic changes below the 1000 ppb mark, some metabolomic and transcriptomic changes occurred even at the lowest concentration. Functional analyses of the observed changes revealed at least three major modes of action: alteration of PPAR signalling and lipid metabolism, effects on cell-cell interaction, perhaps linked to effects on the immune response and neuronal system development, and a general alteration of the development, reflected by an alteration of different development- and metabolism-related signalling pathways, likely affecting to cell cycle functions, and

Obesogens and lipid disruptors (P)

WE028 Unraveling distinct pathways of PFOS toxicity by combining morphological, metabolomic and transcriptomic analyses

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Obesogens and lipid disruptors (P)

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Obesogens and lipid disruptors (P)
to the metabolism of proteins, nucleotides, and amino acids. The results suggest a complex, multiple endocrine disruption-like toxic effects, at concentrations well below the 1 ppm considered the LOAEC/NOAEC for many of the macroscopic effects traditionally linked to PFOs toxicity in zebrafish embryos, including lipid disruption, effects to sensorial organs, and lethality. It is also remarkable the functional correlation between these macroscopic effects and the molecular changes we observed at metabolic and/or transcriptomic levels at concentrations 10 to 100 below the macroscopic NOAEL. 

WE028 Impacts of fatty acids and methylmercury on preadipocyte differentiation in rainbow trout (Oncorhynchus mykiss). G. De Blacam, University of Porto; J. Martinez, Universidad Autónoma de Baja California Sur. The rise of obesity in humans is a major health concern of our times, affecting a substantial portion of the world population. In recent years, the occurrence and fate of pharmaceuticals in the aquatic environment has become an increasing environmental concern. One of the most relevant concentrations of metformin and its metabolite, guanylurea was exposed to 3.2 µg/L metformin from embryo through 28 day post hatch. When male medaka were exposed to an extremely low concentration of guanylurea (1.0 ng/L), there was a similar percent decrease in length and wet weight (~22%; mg) of male Japanese medaka (Oryzias latipes) when exposed to 3.2 µg/L metformin from embryo through 28 days post hatch. Using radio labeled metformin, we demonstrated that about 1% of the waterborne concentration of metformin could be taken up in both embryo and larval medaka after exposure windows ranging from 24 hours to 7 days. We also conducted a metabolomics assessment of metformin and guanylurea exposed fish to elucidate the sub-lethal biochemical mode of action for each contaminant exposure. Significant changes were detected in the metabolome of 28-day larval male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. This biochemical effect is likely a contributing factor to the observed decreased growth in exposed fish. In combination, these results suggest that the current concentrations of metformin and guanylurea in receiving waters are of ecotoxicological concern for resident fish populations.

WE032 Levels of proteins, carbohydrates, lipids and cholesterol in the digestive gland of juvenile catarina clam Argopecten ventricosus (Sowerby, 1842), exposed to toxic metals A. Sebrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Instituto Politecnico; C. Cáceres, Universidad Autonoma Metropolitana Iztapalapa / Universidad de California Sur. The analysis of the composition of the digestive gland, gives information on the energy level of the organism, this energy is mobilized in the different stages of its life cycle. When the organisms are subjected to severe stress conditions, it has been observed the mobilization of these reserves to maintain homeostasis, in short periods of time. In this work, an evaluation of the composition of the digestive gland of juvenile catarina clam exposed to the metals Cd, Cr, Pb and their mixtures was carried out to determine their energy content. Bioassays with water replacements were carried out. The organisms were exposed to 1 sublethal concentration of each metal (LC50) 0.35, 5.0 and 3.0 mg L-1 of Cd, Cr and Pb.
respectively) and of the mixtures in proportion 1:1. The levels of proteins (Lowry, 1951), carbohydrates (Dubois, 1956), lipids (Bligh and Dyer, 1959) and cholesterol (Kit Biorad) were quantified at 24, 96, 144 and 168 hours after the start of the bioassay. The Kruskal-Wallis test showed that the difference between the concentrations of proteins, lipids, cholesterol and carbohydrates of the control group compared to the treatments was significant (p < 0.034). An increase in cholesterol levels was observed at 24 hours of exposure and a decrease in protein, lipid and carbohydrate levels of up to 75% in only 96 hours (4 days) of exposure to metals and their mixtures. This indicates that juveniles exposed to metals had high stress levels, (as was also observed in relation O:N). It should be mentioned that the surviving organisms of the tests, died 48 hours (2 days) after it was observed the mobilization of their energy reserves.

Environmental risk assessment and management of the spoil material produced in tunnelling excavation (P)

WE033 Environmental assessment of foaming agent persistence in conditioned soil for EPB-TBM tunnelling


Earth Pressure Balanced Shields are currently the most used full face tunnelling machine thanks to the wide use of conditioning agents in different soil types that change the mechanical and hydraulic behaviour of the soil into a plastic paste, permitting soil pressure applications in the bulk chamber. The most frequently conditioning agents used for soil in the bulk chamber are various types of foams that are mixed to the soil from injection points located on the cutter head and inside the bulk chamber to give the conditioned soil properties necessary to guarantee that the EPB machine will work in the proper way. The excavation process produces a large amount of spoil material rich in foaming agents that can have an impact on ecosystems. The possible way-of-reuse of the excavation products strongly depend on the additive composition, on soil properties and environmental conditions. Currently, there are neither soil thresholds in European legislation for these components nor comprehensive studies on their environmental risk and persistence for soil ecosystems in these exposure scenarios. In this context, the objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained in two common commercial foaming agents in two different soils (S1: silty-clay; S2: gravel in a clay-silty-sand matrix soils) sampled from a construction site. Moreover, the degradability of one product was evaluated in the presence of an additive used to improve the compactness and subsequently transport of the spoil material. For this purpose, microcossms were set up using soil samples conditioned separately with the two foaming agents. Control microcossms, consisting of untreated soil, were also set-up to compare the microbial community before and after the foaming agent addition. At selected times, soil samples were collected for assessing SLES concentration by ASE extraction followed by MBAS spectrophotometric method. Microbiological analyses were performed in order to assess microbial abundance, viability and dehydrogenase activity in the conditioned and control soils. Results showed that SLES degradation depended on the soil type, with DT_{50}, ranging from 11 to 19 days; the additive increased significantly the surfactant persistence especially in the S2 soil. In the latter case, the higher persistence of the product can be ascribable to the detrimental effect of the additive on the microbial abundance and activity.

Application of the Vibrio fischeri acute toxicity test to assess the environmental impact of spoil materials containing foaming agents


The rapid development of TBM’s in the tunnelling industry has been mainly due to their advantages over conventional excavation methods, such as continuous operation, safer working conditions and reduced damage at surface level and higher tunnelling speed. The performance of TBM’s relies on the use of appropriate soil conditioning foaming agents containing water solutions of anionic surfactants, mainly sodium lauryl ether sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material from excavation processes can be re-used as by-products if the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C<12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits established in the European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its ecotoxicological effects on soil and water organisms. The use of ecotoxicological tests makes it possible to overcome the analytical limits to detect multicompontent commercial foaming products (of which the complete composition is often unknown), to save time by avoiding the designing of new analytical methods for the increasing number of chemicals used in new foaming formulations continuously being put on the market. Above all, they provide information about the different interactions between the mixture and the specific matrix and the possible ecotoxicological effects on biota. In several studies conducted to evaluate the environmental impact of spoil materials the bacterium Vibrio fischeri showed to be very sensitive to the residual concentrations of the surfactant SLES in eluates obtained from soil samples collected from excavate sites. The overall analysis of a set of chemical and ecotoxicological data showed that the bioluminescence inhibition was directly related to SLES concentration. Consequently, the ISO 11348-3:2007 test is a suitable tool to assess in a short time the occurrence of foaming agent residuals at effect concentrations in spoil material.

Biodegradability of the anionic surfactant sodium lauryl ether sulphate used as the main component in two foaming agents for tunnelling process

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The sodium lauryl ether sulphate (SLES) is the main component of most commercial products used for soil conditioning in the excavation industry, in particular as lubricants for mechanised tunnelling. This excavation process produces large amounts and types of soil materials that can have a potential impact on ecosystems. The lack of accurate information about SLES persistence in the environment has aroused increasing concern for their possible recycling as construction materials or as soil replacement for covering rocky areas. Currently, there are neither SLES soil thresholds in European legislation, nor comprehensive studies on the environmental risk for soil ecosystems in these exposure scenarios. The objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained in two common commercial foaming agents (P1, P2). For this purpose, a set of microcossms was set up using two different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) from the construction site. Microcossms experiments were set-up with soil samples conditioned separately with the foaming agents P1 (83 mg/kg SLES concentration) or P2 (83 mg/kg SLES concentration). Some soil samples were previously sterilized in order to evaluate abiotic degradation in absence of the microbial community. Moreover, control microcossms, consisting of untreated soil, were also present in order to compare the microbial community before and after the foaming agent addition. At selected times (0, 7, 14, 21, 28) soil samples were collected for assessing SLES concentration by ASE extraction followed by MBAS spectrophotometric method. Microcossms analyses were performed in order to assess microbial abundance (DAPI counts), cell viability (Live/Dead method), dehydrogenase activity and the phylogenetic structure of the microbial community by the Fluoresce In Situ Hybridization (FISH) method. Although an initial negative effect on microbial abundance and viability was observed, at the end of the experiment SLES was no longer present in all soils. The two foaming agents showed to be comparable between treated and control soil. SLES was completely biodegraded at day 28 and a shift in the microbial community was observed comparing the control vs treated soils. In particular, a significant increase in the Gamma-Proteobacteria group, which includes bacteria able to transform SLES, has been found.

Development of new foaming agents with better environmental impact for EPB soil conditioning - The Polyfoamer ECO line

a.boscare, e. dal negro, Mapei SpA / Underground Technology Team; m. stefanoni, Mapei SpA / R&D

1. Foaming agents with better environmental impact: the POLYFOAMER ECO line Thanks to the development of new foaming agents carried out by the R&D Group, MAPEI have created the new product line Polyfoamer ECO, with the main goal to reduce the environmental impact on the tunnel muck, thus facilitating the re-use of the tunnel muck as by-products, in example for road constructions or old quarries refilling. All the new Polyfoamer ECO foaming agents are characterized by lower COD at the initial concentration and lower cellular viability as well as having a higher ability to mineralize the lowest class of risk agents waters and organisms associated to a chemical product, according to the German regulation. The new products Polyfoamer ECO/100 and Polyfoamer ECO/100 Plus are characterized by lower values of COD at the initial stage when compared to traditional products, meaning that their provision of organic material to the conditioned soil is lower. The environmental results with soils conditioned with the Polyfoamer ECO products Various laboratory tests have been carried out with the new foaming agents of the Polyfoamer ECO line of products and samples of soil coming from different TBM projects. The results obtained with two samples of soil from an Italian project are described: the material called “M” (a 337 SETAC Europe 28th Annual Meeting Abstract Book
Determination of anionic surfactants by Pressurized Liquid Extraction (PLE) followd by the modified Methylene Blue Active Substances (MBAS) method in spoil material from excavation processes


Recent years have been characterized by a rapid worldwide growth in underground constructions in the form of new infrastructures such as pipelines and communication cables as well as road and railway tunnels. The utilization of underground space offers a new strategy to urban planning, including a huge development of mechanized tunnelling industry by the use of Tunnel Boring Machines (TBMs). Performance of TBMs depends on the composition of appropriate soil conditioning products, principally foaming agents. Anionic surfactants are the main constituents of commercial foaming agents widely used as lubricating products in the mechanized excavation, improving the stability of the excavation face and reducing the friction between soil cuttings. Among the anionic surfactants, sodium lauryl ether sulphate (SLES) is the most utilised compound in the commercial products for the excavation industry. Significant amounts of rock broken into various sizes mixed with anionic surfactants are produced during the execution of engineering works. The potential re-use of this non-renewable natural resource, for example as land covering, depends on the assessment of its environmental competency; otherwise, the spoil materials must be treated as a waste. In this context, it is important to evaluate the residual concentrations of SLES in the excavated soils in order to evaluate their possible final destination. Given the absence of official analytical methods, it has become necessary to develop and validate a reliable and accurate methodology to quantify anionic surfactants in the spoil materials and, more in general, in the environmental solid matrices. For this purpose, the aim of the present work was the optimization of an analytical method for the determination of SLES in conditioned-soil samples. It consists of a first phase of extraction of anionic surfactants from the soil by the use of Pressurized Liquid Extraction (PLE) and the following analysis in the extract by the MBAS (Methylene Blue Active Substances) method using the water official method partially modified. The optimised method has been applied to real excavated soil samples because the determination of residual concentrations of the anionic surfactants in the spoil materials produced during excavation process, is currently one of the mandatory parameters for assessing their eco-compatibility.

Determination of anionic surfactants by Pressurized Liquid Extraction (PLE) followed by the modified Methylene Blue Active Substances (MBAS) method in spoil material from excavation processes


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Distribution and persistence of anionic surfactants in leachate and conditioned soil: mesocosm study for EPB applications


The development of the mechanized tunnelling industry by EPB-TBMs (Earth Pressure Balance -Tunnel Boring Machines), results in a wide use of foaming agents and polymers as lubricating products for soil conditioning. Anionic surfactants, and in particular sodium lauryl ether sulphate (SLES), are the main components of foaming commercial products. Soil debris from excavation processes can contain residual concentration of SLES. The potential re-use of the spoil material for public green areas or industrial purpose (e.g. land covering) depends on the site-specific SLES persistence in the excavated soil and on the related environmental exposure scenario. In this context, we evaluated the SLES leaching in different soils in order to simulate check whether underground water contamination may occur in a scenario where the spoil material is located close to a water body. For this purpose, we evaluated the persistence (DTₚₙ) of SLES in two soils (S1: silty-clay soil; S2: gravel in a clay-sandy matrix soil) conditioned separately with two common commercial foaming agents, respectively F1 and F2, used at conditioning ratio giving final concentration in both the soils of about 150 mg/kg. The presence of strengthening foaming polymers (P1 or P2, 527 and 50 mg/kg respectively), needed in some cases to increase foam persistence, was also considered. After a preliminary phase at laboratory scale, a mesocosm experiment was conducted in order to entail the scale-effect, which is very significant when the soils are involved. SLES solutions were set-up mixing 100 kg of each soil with water, foam and polymer and then stored for 28 days in high-density polyethylene bins (HDPE diameter of 30 cm and height of 100 cm). The effect of soil type, grain size or aeration on SLES persistence was evaluated. For this purpose, eight bins containing S1 or S2 conditioned separately with the two foaming agents, were weekly turned to improve aeration, while the corresponding eight blends were not turned. At selected times (0, 4, 7, 12, 20 and 28 days), soil and leachate samples were collected from the bins for assessing SLES concentration by MBAS spectrophotometric method, preceded by ASE (Accelerated Solvent Extraction) in the case of the soil matrix. The results showed that residual SLES concentration in soil and in leachate is dependent both on the type of soil and on the nature of polymers.
agent products are anionic surfactants such as the alkyl ether sulfates (AES). The possible re-use of huge amounts of spoil material produced during the excavation process as by-products (e.g. land covering) or its discharge as a waste depends on the residual concentration of AES in the soil. The first option has the undoubted advantage to lower the costs of disposal. However, there are concerns about the potential environmental risk related to the re-use of conditioned soil. In fact, even if anionic surfactants are generally considered biodegradable and not toxic, there is little information in literature on their environmental fate and the possible ecotoxicological effects of the commercial formulations of foaming products and of the conditioned soils. The aim of this study was to evaluate the environmental compatibility and the ecotoxicological effects of two different soils treated with two different foaming agents containing the anionic surfactant AES, applying a suitable battery of bioassays. For this purpose, a set of chemical analyses was performed, containing two soils with different geopedological characteristics, conditioned with two foaming agents at the same treatment ratios (TR, L/m³) used for mechanized drills. Soil samples were collected at different maturation times (0, 7, 14, 28 days) in order to perform the ecotoxicological tests on the spoil material or in its aqueous extracts. The bioassays selected are representative of different trophic levels for the aquatic and terrestrial compartments: Microtox test with the bacterium Vibrio fischeri, Fish Embryo Acute Toxicity Test (FET) with the species Danio rerio, germination and growth test with the plant Lepidium sativum and test with the worm Eisenia fetida. In parallel, sub-samples of soil and elutriate from each mesocosm were analyzed in order to determine the residual concentrations of the anionic surfactant AES. The overall results obtained showed different ecotoxicological response depending both on the kind of soil. Commonly accepted standards were tested. The developed study highlights the importance of a site-specific ecotoxicological evaluation in the tunneling projects in order to have a real environmental compatibility of the spoil material.

WE041 Expeditious test for on-site monitoring activity in mechanized tunneling applications
In the vast majority of tunnel projects performed with TBM-EPB technology a key issue is currently represented by the disposal management of the spoil, huge amount of excavated material mainly composed by the natural soil, water and chemical inert additives used to access the tunnels. The process to collect the spoil has to be developed in a virtuous cycle of reuse of the resources leading to relevant economical and logistical advantages. The raising awareness about the chemical composition of the products injected during the excavation resulted in the development of experimental procedures aimed at studying the environmental impact of chemicals and their permanence in the soil during the excavation and after the completion of the tunnel. In particular, many studies have been devoted to evaluate the effect of specific concentration values of these chemicals on terrestrial and aquatic environments, as well as to measure the reduction of the concentration of these compounds in each environment due to the action of the microorganisms inhabiting them. All these experimental procedures must be carried out in specialized laboratories equipped with sophisticated apparatuses, in which controlled environments are predisposed, so that at present it’s not possible to measure the level of pollution through expeditious tests directly on site. A joint research activity between Sapienza University and National Research Council of Rome has developed a test procedure able to provide expeditious information on the presence in the spoil of the chemicals often used in mechanized tunneling. The results of preliminary laboratory tests convinced that the expeditious assessment proposed can describe the amount of chemicals in the soil and their evolution in time, complementing the laboratory activities currently accepted. In fact, this fast procedure must be regarded as a first screening which can be run directly in site on a large number of samples without the use of expensive, delicate or complex instruments, to be used in combination with few more precise laboratory tests. Moreover, the test seems to be particularly suited for monitoring large voids as those involved in tunnel excavation. The intention for the future is to apply the procedure to real cases to verify, through a comparison with the most accurate laboratory tests, the actual effectiveness of this procedure.

WE042 Toxicity of several additives used in mechanized tunneling: effects on daphnids, algae and cress.
D. Baderna, S. Maiorana, A. Passoni, R. Bagnati, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; M. Lodi, E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences
Surfactants and polymers are used in mechanized tunneling to facilitate the excavation and to preserve the tunnel boring machine (TBM) from wear, block and break. As a by-product of the process, several tons of rocky debris are produced. These excavation rocks are made of rock fragments contaminated by the additives such as anionic surfactants, glycols, sealants, polycrylates and polycrylamides. In the past, rocky debris were disposed as waste with a large economic impact on total excavation cost, while some disposal alternatives were recently applied, trying to recycle these complex materials as road filling material, covering rocky areas or river banks. These disposal solutions, however, have attracted the attention of regulators and environmental protection agencies, especially in Italy. In fact, the toxicology of these active mixtures is not yet fully known as well as the potential effects deriving from the simultaneous presence of additives with other regulated environmental contaminants such as, for example, metals and hydrocarbons. A preliminary study recently conducted by our group on three commercial TBM additives showed toxic effects on the aquatic ecosystem in concentrations comparable to those resulting from excavations carried out in Italy. This new study analyzes 8 surfactants and 4 commercial polymers, using a multidisciplinary approach to determine their reference thresholds for both water and soils, accounting of the effects on ecological targets. The chemical composition of the technical mixtures was determined by liquid chromatography coupled with high resolution mass spectrometry. The main chemical components were analyzed in silico to highlight the potential similarity with other pollutants, already listed in our environmental framework regulation. Finally, the toxicity of the various agents has been evaluated by tests with Daphnia magna, freshwater algae and cress. Chemical characterization identified 15 molecules present in all the surfactant mixtures, although in different proportion. No similarities with compounds already regulated by the Italian Environmental Act were found by the in silico analysis. All the tested surfactants were toxic for the aquatic organisms at concentrations comparable to those that can be found in leachates of conditioned rock debris. The additives resulted non toxic for the terrestrial plant at concentrations theoretically found in conditioned rock debris.

PBt/PvP & PMt/PvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (P)

WE043 Bioaccumulation, tissue distribution, and trophic magnification of organic ultraviolet absorbents in freshwater ecosystem in the Pearl River catchment, China
X. Peng, Z. Zhu, S. Xiong, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences
Bioaccumulation and trophic transfer of 13 organic ultraviolet absorbents (UVAs) were investigated in riverine wildlife organisms in the Pearl River catchment, South China. The UVAs were widely present in the fish with the highest level detected for UV 531. Generally, the UVAs concentrations were higher in the freshwater fish than in shrimp. Dietary habits of the fish showed effects on bioaccumulation of the UVAs with higher levels in the carnivorous species than in the herbivorous, planktivorous and detritus feeding fishes. Tissue distributions were generally in the order of liver > belly fat > muscle. Obviously higher concentrations of 2-ethylhexyl-4-trimethoxycinnamate were detected in eggs than in muscle, probably indicating maternal transfer of the compound. The calculated bioaccumulation factors (LogBAFWere usually > 3.3, suggesting potential of the UVAs in the freshwater fish. UV 531 showed tendency of bioaccumulation in the fish from the sediment indicated by the calculated BSFA > 1. The estimated trophic magnification factors were > 1 for some benzotriazole stabilizers, suggesting potential of biomagnification of the UVAs in the freshwater fish.

WE044 Hyalella azteca as non-vertebrate alternative species for bioaccumulation studies
M. Habekost, BASF Corporation; N. Kreling, BASF SE / Crop Protection - Ecotoxicology; B. Kusebauch, M. Obermann, BASF SE Agrarzentrum Limburgerhof
Bioaccumulation is one of the PBT (persistence, bioaccumulation, toxicity) cut-off criteria for plant protection products (EC/1107/2009) in the EU; furthermore, high bioaccumulation is generally considered a critical parameter in other regions, too. The standard regulatory assessment of bioaccumulation is based on bioconcentration in aquatic species, i.e. for regulatory purposes in fish. However, standard fish bioconcentration studies are time consuming, expensive and they use a considerable number of fish species. Therefore there is a need for a relatively quick, cheap, and preferably alternative test method that enables the ranking of structurally clustered candidate molecules regarding bioaccumulation potential and the prediction whether a candidate molecule will exceed the BCF (bioconcentration factor) trigger value. Furthermore, Hyalella azteca might in the long-term perspective be able to replace fish for BCF testing. There is indication that experimental BCF values from fish through bioaccumulation studies with Hyalella are similar to those obtained from fish (Schlechtrem, 2012). Further work is presented in order to (i) increase the data base of Hyalella – fish BCF data sets covering a wide range of BCF values (i.e. 100 to 20 000), (ii) to standardize and simplify the test system and (iii) to check the suitability of the test system for molecules with an insecticidal mode of action which poses inherent challenges covering a wide range of BCF values (i.e. 100 to 20 000), (ii) to standardize and simplify the test system and (iii) to check the suitability of the test system for molecules with an insecticidal mode of action which poses inherent challenges.
Bioaccumulation of ionizable organic chemicals in fish - The quest for reliable predictors

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Bioaccumulation in fish is quantified using biomagnification factors (BMFs), which are derived from controlled conditions according to OECD guideline 305-III. To reduce in vivo experimental efforts, pre-screening using statistical models for BCF prediction is becoming increasingly popular. While dietary bioaccumulation of neutral chemicals has been successfully associated to lipophlicity descriptors, no suitable predictor has yet been identified for ionizable chemicals. In this study, we investigated the capability of selected chemical properties (e.g., molar volume, adsorption to albumin, lipophlicity, solubility, topological polar surface area) to predict bioaccumulation of organic electrolytes in fish with specific focus on dietary exposure studies. Measured dietary BMFs were collected from existing literature, and empirical correlations with measured or estimated chemical descriptors were evaluated. The dataset includes dietary BMFs in whole fish obtained under laboratory-scale conditions closely resembling or directly referring to the OECD 305-III guideline. In total, BMF data were available for 29 ionizable chemicals (of which 10 are perfluorinated chemicals), including 24 acids and 5 permanently ionized chemicals at environmental pH (range 3 to 9). A parallel dataset was compiled with bioconcentration factors (BCFs) of the same chemicals derived in water exposure studies with fish (OECD 305-1 guideline). Bivariate correlation analysis (Pearson and Spearman) revealed that a logKOW was not a sufficient predictor of BMF, although with significant positive correlation (R=0.40), and b) that significant correlation was shown only with logKOW at pH ≈ 3 (R=0.35). Furthermore, significant negative correlation was shown between BMF and solubility (R < -0.60). These preliminary results indicate that commonly used predictors for bioaccumulation (e.g., logKOW) are of limited relevance for ionizable chemicals, and other predictors should be identified. Ongoing research is focusing on the prediction of BCF from quantum-chemistry-based estimations of partitioning coefficients (to account for charge-lipid interactions in fish). Estimation of BCFs from BMF for the investigated chemicals will be also performed and verified with existing BCF measurements. Eventually, identified empirical regressions between BMF and chemical descriptors will be validated with ad hoc experimental data with radiolabelled test chemicals.

Evaluation of a tiered approach for the bioaccumulation assessment of fragrance substances: in silico, in vitro assays, invertebrate vs. in vivo fish bioconcentration test

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Bioaccumulation is a key endpoint in environmental hazard and risk assessment, especially for substances with a high octanol water partition coefficient (logKOW). To measure the BioConcentration Factor (BCF), a tiered approach is followed starting from the assessment of the octanol water partitioning coefficient as a measure for lipophlicity, which is often used as surrogate for lipid partitioning up to an experimental BCF value which is considered as the gold standard for fish bioaccumulation assessment. We have applied a series of non-animal tests to predict the BCF values and compared those outcomes to the results from a BCF test in order to validate this alternative approach. Several fragrances from the tetranorlabdane diterpenoids family, either composed of a single or a mixture of stereoisomers were tested. The logKOW predicted by QSAR ranges from 4.75-5.41 and 6.2 when determined by HPLC (OECD 117). The slow stir method (OECD 123) provides a logKOW of 5.09 which is retained as the reference value. Various structure-activity relationship models were used to predict the fish bioconcentration factor, which ranged from ~1000 to ~4500, not exceeding the EU criteria for (very) Bioaccumulative substances (vB), however, the structure was mostly outside the applicability domain of the models. Therefore in vitro assays were conducted on rainbow trout S9 fractions and hepatocytes confirming the potential of this biotransformation; the refined BCF values calculated with IVIVE extrapolation models were <1000. In addition the bioaccumulation potential of one isomer was investigated in a flow-through test on the invertebrate Hyalella azteca resulting in a BCFSS or kinetic < 500 L/kg. Finally an experimental fish BCF of ~500 (OECD 305) confirms that the fragrance composed of various isomers is not bioaccumulative, and supports the in vitro biotransformation findings. Histopathological results from toxicological studies showed liver hypertrophy consistent with the increased metabolism associated with detoxification processes. A tiered weight-of-evidence approach is clearly justified for the current bioaccumulation assessment, confirming that the tests described in the abstract may offer alternatives to animal testing when sufficient and supportive evidence is provided.

Proposal for a freshwater trophic magnification study based on a Comprehensive literature evaluation


Bioaccumulation potential is a critical property used for the risk assessment of chemicals and is usually expressed by parameters derived from laboratory or field experiments, in particular bioconcentration-, bioaccumulation- and biomagnification factors. A relatively new approach is the determination of so-called trophic magnification factors (TMF) which integrate enrichment processes in the food web or a related chemical body. Therefore the aim of this study is to define a sound concept for TMF investigations to enhance both, the reproducibility and accuracy of TMF estimates to allow the regulatory usage of this endpoint. The developed concept focuses on freshwater habitats, covers different invertebrate and fish species and will be tested in a proof of field study. A water body will be selected under consideration of several aspects such as the chemical burden of the water body, the type of contamination source, and species diversity in the water body. Invertebrate and fish species will be collected in the water body during spring/summer 2018. The trophic levels of the species will be determined applying different methods such as comparison of stable isotope patterns in the chemical of interest, or against a baseline organism (including stable isotope analysis of different amino acids). Sample handling will follow the protocols applied by the German Environmental Specimen Bank (ESB) including cryo-milling, homogenization, sub-sampling, and long-term storage. During all processing steps samples will be kept constantly at a temperature < -150°C. The sample material obtained will be analyzed to derive TMF estimates for different compartments in a food web or a related chemical body. Different statistical methods and models will be applied. The validated concept may provide the framework for a new TMF testing scheme integrated in the German Environmental Specimen Bank (ESB).

Obstacles in identifying PBT/vPvB-substances under REACH for high tonnage chemicals


Obstacles in identifying PBT/vPvB-properties under REACH for high tonnage chemicals include dietary BMFs that do not fully comply with guideline 305) confirms that the fragrance composed of various isomers is not bioaccumulative, and supports the in vitro biotransformation findings. Histopathological results from toxicological studies showed liver hypertrophy consistent with the increased metabolism associated with detoxification processes. A tiered weight-of-evidence approach is clearly justified for the current bioaccumulation assessment, confirming that the tests described in the abstract may offer alternatives to animal testing when sufficient and supportive evidence is provided.

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Obstacles in identifying PBT/vPvB-substances under REACH for high tonnage chemicals


Obstacles in identifying PBT/vPvB-properties under REACH for high tonnage chemicals include dietary BMFs that do not fully comply with guideline 305) confirms that the fragrance composed of various isomers is not bioaccumulative, and supports the in vitro biotransformation findings. Histopathological results from toxicological studies showed liver hypertrophy consistent with the increased metabolism associated with detoxification processes. A tiered weight-of-evidence approach is clearly justified for the current bioaccumulation assessment, confirming that the tests described in the abstract may offer alternatives to animal testing when sufficient and supportive evidence is provided.
In the risk management of chemicals there is an increasing demand to assess the economic, social and environmental impacts of regulatory measures in order to facilitate political decision-making. Within REACH, socio-economic analysis (SEA) is the tool to assess and balance positive and negative impacts of different policy options. Currently, persistent, bioaccumulative and toxic (PBT) and very persistent, very bioaccumulative (vPvB) chemicals are regulated on the basis of their different properties. These imply a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazard and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may thereby be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examined what parameters are considered most relevant to characterise the concern of PBTs/vPvBs. Furthermore, it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

**WE049**

**PBT/vPvBs: All equally bad or some worse than others? - How to inform risk management**

K. Thiele, WUR; S. Gabbert, Wageningen University / Social Sciences

In the risk management of chemicals there is an increasing demand to assess the economic, social and environmental impacts of regulatory measures in order to facilitate political decision-making. Within REACH, socio-economic analysis (SEA) is the tool to assess and balance positive and negative impacts of different policy options. Currently, persistent, bioaccumulative and toxic (PBT) and very persistent, very bioaccumulative (vPvB) chemicals are regulated on the basis of their different properties. These imply a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazard and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may thereby be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examined what parameters are considered most relevant to characterise the concern of PBTs/vPvBs. Furthermore, it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

**WE050**

**Modelling Persistent & Mobile Organic Compounds using an updated Multimedia Urban Model: A Toronto Case Study with Organophosphate Esters (OPEs)**

T.D. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; L. Jantunen, Environment and Climate Change Canada; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; M.L. Diamond, University of Toronto / Department of Earth Sciences

Organophosphate Esters (OPEs) are a group of chemicals found at relatively high levels in the environment, a polyparameter linear free energy relationships (ppLFERs) to represent partitioning, solubility and molecular charge, for example. Currently, the majority of large-scale multimedia models are currently being used to assess the environmental fate and risk of PBT/vPvB substances with the aim to support regulatory decision-making. The usage of OPEs has increased in recent years following the listing of penta- and octa-BDEs as POPs under the Stockholm Convention. In contrast with BDEs, OPEs are highly polar molecules which can be considered persistent and mobile organic compounds (PMOCs). We modified the Multimedia Urban Model (MUM) of Diamond and co-workers by using a polymer parameter linear free energy relationships (ppLFERs) to represent partitioning, and will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

**WE052**

**Polymers: The Next Frontier in Environmental Hazard Assessment**

A. Carrag, Kao USA / R&D; T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science; J. Coleman II, Kao USA / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science

Polymers are a very large and diverse class of chemicals widely used in cosmetic and personal care products. Their use and function are essential in creating high performing products that meet the needs of consumers. As used in cosmetic formulations, polymers can act as thickeners, emulsifiers, conditioners, opacifiers, film formers, rheology modifiers, etc. In the simplest terms, according to the Oxford Dictionary, a polymer is a substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together. They have a wide range of physical-chemical properties including a wide breadth of solubility and molecular charge, for example. Currently, the majority of large molecular weight polymers are exempt from chemical regulations around the world (e.g. REACH) or are largely considered of low concern based on a minimum set of physical-chemical properties (FIFA, 2008). However, there is a speculation that these regulatory exemptions, specifically the REACH exemption, could be removed in the next 5-10 years. If this is the case, many previously untested chemicals would then need an environmental hazard assessment supported by an ecotoxicological dataset. This dataset may include aquatic toxicity testing, read-across to structurally similar chemicals that have been tested, weight of evidence toxicity estimates based on physical-chemical properties, or all of the above. However, the same variety of physical-chemical properties that allows polymers to have so many functions in cosmetic formulations also makes these substances difficult to test in aquatic systems – varying absorption properties, molecular charge, insolubility, etc. Therefore, safety assessors evaluating polymers must look to new and novel approaches for filling environmental data gaps in order to create a robust environmental hazard assessment. This poster will examine the current polymer landscape for cosmetic uses, identify common data gaps, provide possible solutions to fill those data gaps, and offer a prioritization strategy for future testing of polymers. Ultimately, the objective is to suggest a more modern approach to substantiating the environmental safety of the large variety of polymers used in cosmetic and personal care products.

**WE053**

**A consistent Approach for PBT/vPvB Assessment for Pharmaceutical Products**

E. Noir, SmithersViscenti / Department of Regulatory Affairs; K. Malekani, SmithersViscenti / Environmental Fate and Metabolism

**Keywords:** Persistence, bioaccumulation, Toxicity, Pharmaceuticals Track 6: Environmental policy, risk management, and science communication. Session 6.7: PBT/vPvB Assessment: Update on regulatory guidance,
requirements, strategies and challenges. Abstract A PBT substance is one that is persistent (P), bioaccumulative (B) and toxic (T) or very persistent (vP) and very bioaccumulative (vB). The PBT assessment approach is well described under the REACH regulation (Regulation EC No 1907/2006) starting with a screening process based on available data and when a potential PBT is identified, then a definitive assessment is required. While this procedure is clearly understood for industrial chemicals, it is less well understood for REACH-regulated pharmaceuticals. There is also no definitive PBT/vPvB guidance for pharmaceuticals, but the European Medicines Agency (EMA), although it is recommended that the assessment be made according to REACH criteria. Application of the REACH guidance to the PBT assessment of pharmaceuticals is not straightforward. A PBT evaluation of a substance is triggered within REACH if more than 10 tonnes of the substance is used per year. There is no established trigger value for performing a PBT assessment for pharmaceutical products, although it appears that a PBT assessment is applicable to pharmaceutical products that go into Phase II. However, we experience is that there is room for interpretations during the review process – especially for products that end at Phase I. Some RMS have consistently rejected the use of all available data; especially data derived from QSARs and instead treat the product as non-PBT. Furthermore, the timeline for a definitive PBT assessment is not regulated. This presentation will describe our experiences and the challenges we have encountered in performing PBT/vPvB assessments for pharmaceutical products, including an overview of typical review comments from CoR (Rapporteur) are discussed. We also discuss review options for the improvement of PBT/vPvB assessment for pharmaceuticals.

WE054 Evaluation of new assessment methods and enhancement of PBT/vPvB criteria for ionisable substances

H. Holzmann, RWTH Aachen University; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

The identification of persistent (P) bioaccumulative (B) and toxic (T) substances under the EU regulation REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) was developed to assess neutral organic compounds. However, nearly 50% of the chemicals pre-registered at the European Chemicals Agency (ECHA) are partly or completely ionised under environmental conditions (Franco et al., 2010). Since the charge of chemicals strongly influences their properties and environmental behaviour, the currently valid concept under the REACH regulation does not provide a sufficient assessment of ionisable substances. The objective of the project is to refine the P assessment of ionic and ionisable substances under REACH. For this purpose, simulation tests following OECD guidelines are conducted using two different types of environmental compartments: Aerobic and Anaerobic Transformation in Aquatic Sediment Systems (OECD 308) and Aerobic Mineralisation in Surface Water (OECD 309). As model substances we have encountered in performing PBT/vPvB assessments for pharmaceutical products, including an overview of typical review comments from CoR (Rapporteur) are discussed. We also discuss review options for the improvement of PBT/vPvB assessment for pharmaceuticals.

WE055 Assessment of the persistence of ionisable or ionisable organic chemicals under REACH

D. Classen, RWTH Aachen University / Institute for Environmental Research; J. Ackermann, Federal Environment Agency Umweltbundesamt / Chemicals; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

For the protection of humans and the environment, the identification and regulation of chemicals with persistent (P), bioaccumulative (B) and toxic (T) properties are central within the environmental assessment. The criteria for the identification of PBT substances under REACH (Registration, Evaluation and Authorization of Chemicals) (EU Nr. 1907/2006) and the guidance for the PBT-assessment have been developed for neutral organic molecules, and do not properly address charged chemicals. Due to their charge, ionic and ionisable substances seem to behave differently in the environment compared to neutral substances. With the addition of cationic, anionic or amphiphilic characteristics, the chemicals intrinsic properties (e.g. water solubility, log Kow) change as a function of the environmental pH. This dependency affects the distribution of these substances within environmental compartments. The ionic function may also lead to different interactions between organic or mineral solid particles and the substance, influencing their bioavailability for potentially decomposing microorganisms, which are governing biotical degradation. In order to improve the evaluation of the persistence of ion and ionisable substances in the PBT-assessment, sorption and degradation patterns of both neutral and ionic substances are investigated. The project is split into two different sub-projects: the first one focuses on a non-charged functional group will be investigated by the sorption behavior of 14C-labelled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonic acid sodium salt and 4-n-Dodecylbenzytrimethylammonium chloride in soil simulation tests (OECD 307) will be investigated according to their mineralized, extractable and non-extractable fraction. Non-extractable residues will be investigated further. In addition, the sorption behavior of the model substances will be determined in a sorption study (OECD 106). The results will enable the estimation of the effect of the positive and negative charged groups within the molecule structure regarding the biodegradability and will improve the evaluation of the persistence of ion and ionisable substances in the PBT-assessment.

WE056 Interaction of sulfonamide with soil humic acid: ESR investigations with nitroxide spin label

A. Riche, E. Bondarenko, H. Steinhoff, University of Osnabrueck / Physics; Ü. K. Hidge, T. Kälai, University of Pecs / Organic and Medicinal Chemistry; M. Mathiesen, University of Osnabrueck / Institute of Environmental Research

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considered to be possibly remobilised in the environment. NER Type 3 (covalently bound residues) and type 4 (biogenic bound NER) are considered to be irreversibly bound to soil/sediment or transformed into biomass and therefore a risk to the environment is not anticipated. Furthermore, a stepwise extraction scheme is proposed which would allow the determination of these different NER types. The comprehensive scientific assessment of this extraction scheme supported by experimental research was funded by UBA.

Transformation tests in soil with $^{13}$C-labeled substances were carried out in accordance with the OECD 307 guideline. Different extraction methods and chemical breakdown procedures were performed and compared in order to characterise the formation of the different NER types. Under consideration of these results, a refined extraction scheme will be proposed with respect to the general applicability for NER assessment in soil. The irreversibly bound fractions have to be considered in assessment of the persistence. An UBA evaluation of regulatory data demonstrate the effects of several influencing factors (e.g. extraction methods, soil type) on NER formation.

**WE058**

**Sorption properties of Ionic organic chemicals: Correlations between ion exchange chromatography retention factors and environmental sorption coefficients**

S. Endo, Osaka City University / Urban Research Plaza & Graduate School of Engineering; L. Henneberger, Helmholtz centre for environmental research - UFZ / Cell Toxicology; K. Goss, Helmholtz centre for environmental research - UFZ / Analytical Chemistry

A common metric for the extent of equilibrium sorption and partitioning, such as the octanol-water partition coefficient (Kow) for neutral organic chemicals, does not exist for ionic organic chemicals. Finding a suitable reference sorption system for ionic organic chemicals should enhance the evaluation, modeling, and prediction of environmentally-relevant sorption coefficients for such chemicals. In this study, we considered ionic exchange materials as possible reference sorption phases and compared their sorption properties against those of various environmental and biological materials. Retention times on commercial ion exchange chromatography columns were measured in fully aqueous eluent and were converted to retention factors ($k'$), which are proportional to the ion-exchanger-water partition coefficients. In the end, we established a data set for retention factors of 61 cations on a strong cation exchange column (SCX), 24 cations on a weak cation exchange column (WCX), and 66 anions on a weak anion exchange column (WAX) measured in consistent experimental conditions (i.e., pH, T, co-existing ions, injected amount). The obtained retention factors were compared to soil organic carbon-water (Koc), clay minerals-water (KCM/w), boronate serum albumin-water (KBSA/w), and muscle protein-water partition coefficients (KMP/w) from the literature. Relatively good correlations ($R^2$ > 0.5-0.6) were found for some cases such as log Koc, log KMP/w, and log KBSA/w against log $k'$ for WAX. For comparison, similar correlation analyses were performed using experimental and predicted log Kow instead of log $k'$. In most cases, the correlation with log Kow were lower than the correlation with log $k'$. Notably, log Kow has a clearly larger applicability domain than log Kow, because log Kow is unavailable for ionic chemicals derived from strong acids/bases (e.g., sulfonates, quaternary ammoniums), whereas log $k'$ can be measured for such ions too. This study opens a field to the development of accurate prediction models for sorption coefficients of ionic chemicals in the environment.

**WE059**

**Simulation of the fate of co-labeled 13C3-15N-glyphosate in a water-sediment system and formation of biogenic non-extractable residues**

A. Brock, DTU Environment / DTU Environment; A. Rein, Technische Universität München / Chair of Hydrogeology; F. Polese, Technical University of Denmark (DTU) / DTU Environment; K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); M. Küster, Helmholtz Centre for Environmental Research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark DTU / DTU Environment

The combination of dynamic simulation and stable isotope techniques allows tracking the assimilation of pesticides into biomass [1]. Here, we simulated the fate of co-labeled $^{13}$C-$^{15}$N-glyphosate in an Oxisol during an aerobic water degradation test [2]. The mathematical model used consisted of two compartments for sediment (slow and rapid ad-/desorption), one compartment for dissolved mass, and microbial growth and metabolism. The flow of both $^{13}$C and $^{15}$N were balanced. The model considers two biodegradation pathways for glyphosate, namely the saccharine-pathway with complete mineralization, and the incomplete pathway with AAs. No stable bound bound with very low biotransformation rates were partially estimated from the data, while others were calculated. The microbial growth yield was predicted from the MTB method, using thermodynamics and chemical structure [3]. The model can capture the dynamics of the system, including degradation of glyphosate, formation of AMPA and CO$_2$, formation of living and dead biomass (proteins) and chemical adsorption. At the end of the experiment (80 days), non-extractable residues accounted for 23% of the $^{13}$C and 26% of the $^{15}$N. 10% of the $^{13}$C and 12% of the $^{15}$N were recovered from the protein fraction (mostly non-living amino acids), which is equal to the biogenic non-extractable residues (NER). Biogenic NER consist of assimilated $^{15}$N$^{14}$N and are thus considered to be ‘irreversibly bound’ as proposed in the updated ECHA guideline for PB/ToxPB assessment [4]. This is the first study simulating the formation of biogenic NER using experiments with $^{15}$N-labeled molecules. [1] Kästner, M., Nowak, K. M., Miltner, A., Trapp, S., & Schäffer, A. (2014). Classification and Modelling of Nonextractable Residue (NER) Formation of Xenobiotics in Soil – A Synthesis. Crit Rev Environ Sci Technol, 44(19), 2107–2171. [2] Wang, S., Seiwert, B., Kästner, M., Miltner, A., Seiwert, A., Rembsma, T., Q. Yang, Nowak, K. M. (2016). (Biodegradation of glyphosate was observed in the labile isotope co-labeling approach. Water Res., 99, 91–100. [3] Brock, A. L., Kästner, M., Trapp, S. (2017). Microbial growth yield estimates from thermodynamics and its importance for degradation of pesticides and formation of biogenic non-extractable residues. SAR QSAR Environ Res, 28(8), 629–650. [4] European Chemicals Agency (2017). Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.11: PB/ToxPB assessment, Helsinki, Finland.

**WE060**

**Determination of persistent organic pollutants (POPs) in soil from sites adjacent to landfills: different provinces of the Republic of Armenia**

A. Alexanyan, Hazardous Substances & Waste Policy Division / Head of Division; Y. Buniyayan, Environmental Monitoring and Information Center / Division of waste inventory, classification and technology investigation; V. Khachatryan, National Institute of Oncology / Thoracic Surgery Department; F. Petrosyan, UNIDO BAT/BEP Project(Armenia)

Sources of environmental pollution by persistent organic pollutants (POPs), either used or merely applied pesticides include landfills, many of which do not meet sanitary and hygienic standards and, at open burning of wastes, become a source of dioxins and furans. Investigation was carried out on soil samples taken in different marzes (provinces) of the Republic of Armenia at the boundaries of landfills and agricultural lands or water basins in the vicinity of towns Ararat (Ararat Marz), Hrazdan (Kotayk Marz), Sevan ( Gegharkunik Marz), Gavar (Gegharkunik Marz), Armavir (Armavir Marz), Ararat (Ararat Marz). In the investigated soil samples, the obtained soil samples were analyzed for determination of the following POPs: - Hexachlorocyclohexane (HCH) isomers: α-, β-, γ-, δ-HCH; - DDT isomers: 2,4′- DDT, 4,4′-DDT; - DDE metabolites: 2,4′-DDE, 4,4′-DDE, 2,4′-DDD, 4,4′-DDD; - Hexachlorobenzene, - Heptachlor, - Aldrin - Dieldrin - Heptachlor epoxide A and Heptachlor epoxide B, - Endosulfan I and Endosulfan II, - Endrin, - Mirex, - 14 Dioxin-like polychlorinated biphenyls: congeners No 77, 81, 105, 114, 123, 126, 156, 157, 167, 169, 180, 189, 189. Quantification of POPs was done using chromatograph with electron capture detector (ECD) equipped with glass capillary column with stable phase DB–5MS UI and the following parameters: 60 m x 0.25 mm x 0.25 μm. Special attention was paid to the total concentrations of HCH isomers, DDT isomers and their metabolites, as well as the total amount of polychlorinated biphenyls, as maximum allowable concentrations (MACs) are set for the aggregate amount of these compounds. On the analogy, concentrations of other POPs pesticides and all studied POPs are also considered on the whole (summary concentrations) as obvious integral indicators of soil pollution by the studied POPs. In the investigated soil samples HCH isomers, DDT isomers and their metabolites, certain Dioxin-like polychlorinated PCBs were detected at concentrations exceeding the established norms.

**WE061**

**Improving the interpretation of Non-Extractable Residues (NER) in degradation assessment**

A. Trapp, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Kaestner, Helmholtz Centre for Environmental Research UFZ / Dept Environmental Biotechnology; S. Trapp, Technical University of Denmark DTU / DTU Environment

Criteria for the assessment of chemical properties, potential (eco)toxicity, and environmental behaviour of industrial chemicals in general, and particularly for REACH substances, biocides, pesticides, and veterinary medicines are summarized in specific European legislations. The regulatory views on NER formation differ considerably, with two extremes of assuming them as either degraded residues of no environmental concern or as bioavailable and non-degraded residues. This may be changed if clear indications for ultimate degradation or irreversible immobilization are available. NER studies as well as the total amount of chemicals in environmental matrices can be experimentally distinguished, sequestered (strongly sorbed and entrapped) residues (type I), containing the parent compound or transformation products or both and having the potential of release. Type II NER are residues that are covalently bound to organic matter in soils or sediments or to biological tissue in organisms. Such residues are considered not potential (eco)toxicity or as irreversible immobilization as they cannot be released, as well as the total amount of NER types of chemicals in environmental matrices can be experimentally distinguished, sequestered (strongly sorbed and entrapped) residues (type I), containing the parent compound or transformation products or both and having the potential of release. Type II NER are residues that are covalently bound to organic matter in soils or sediments or to biological tissue in organisms. Such residues are considered not potential (eco)toxicity or as irreversible immobilization as they cannot be released, as well as the total amount of chemicals in environmental matrices can be experimentally distinguished, sequestered (strongly sorbed and entrapped) residues (type I), containing the parent compound or transformation products or both and having the potential of release. Type II NER are residues that are covalently bound to organic matter in soils or sediments or to biological tissue in organisms. Such residues are considered not potential (eco)toxicity or as irreversible immobilization as they cannot be released.
II NER and type I NER should be considered as potentially releasable residues in persistence assessment but the probability of type II release is much lower. For these types the potential of remobilization needs to be tested and evaluated. Our concept is to consider the total amount of NER minus bioNER as the amount of potentially remobilizable xenonNER (type I + II). If a clear differentiation of type I and type II is possible and the latter is irreversibly bound, only type I NER needs to be considered in the persistence assessment. If no characterization of NER is available, we recommend to assess the total amount as potentially remobilizable.

The use of pesticides has allowed for increased crop productivity in agriculture. However, because of their frequent application onto agricultural lands, their environmental fate is of particular interest. Pesticides have been ubiquitously detected in natural waters throughout Europe as well as in water supplies, which suggests these pesticides may be more mobile and persistent than their initial evaluations indicated. A potential reason for the mischaracterization of these pesticides’ persistence in the environment is the overestimation of degradation pathways in the environment. For example, only direct photolysis in pure water can be considered, but the presence of dissolved organic matter can significantly affect the photolytic fate of pesticides in natural water. The photolytic degradation can either be enhanced by indirect photolysis reactions with photochemically produced reactive intermediates (e.g., triplet state dissolved organic matter, single oxygen, hydroxyl radical), or it can be suppressed by the light screening effect of organic matter once the light enters the water column. This research focused on the photolytic fate of fungicides, which account for approximately half of pesticide usage in Europe, in natural waters. For the several commonly used fungicides investigated, the results show that both direct and indirect photolysis are important to quantify in order to accurately characterize the environmental fate of fungicides.

Study Design Considerations for E-Fate Testing of UVCB Substances

C. Lowrie, Charles River / Environmental Fate and Metabolism

Substances of unknown or variable composition, complex reaction products or biotransformation products. For example, this is the case where a single compound is not fully identifiable and its composition may be difficult to predict. Under REACH Registration, it may be necessary to test these substances, which from many perspectives represents significant challenges. A common approach is to consider the chemical structures in a UVB in groups and to test exemplar molecules or structures from within the mixture. This approach is possible when the individual structures have similar physico-chemical properties and structures are related. However, because of their frequent application onto agricultural lands, their environmental fate is of particular interest. Pesticides have been ubiquitously detected in natural waters throughout Europe as well as in water supplies, which suggests these pesticides may be more mobile and persistent than their initial evaluations indicated. A potential reason for the mischaracterization of these pesticides’ persistence in the environment is the overestimation of degradation pathways in the environment. For example, only direct photolysis in pure water can be considered, but the presence of dissolved organic matter can significantly affect the photolytic fate of pesticides in natural water. The photolytic degradation can either be enhanced by indirect photolysis reactions with photochemically produced reactive intermediates (e.g., triplet state dissolved organic matter, single oxygen, hydroxyl radical), or it can be suppressed by the light screening effect of organic matter once the light enters the water column. This research focused on the photolytic fate of fungicides, which account for approximately half of pesticide usage in Europe, in natural waters. For the several commonly used fungicides investigated, the results show that both direct and indirect photolysis are important to quantify in order to accurately characterize the environmental fate of fungicides.

Photodegradation Half-lives of a Fragrance Ingredient in Natural Waters at Depth Calculated from Laboratory Study Results

J. Apell, MIT / Civil & Environmental Engineering; K. McNeill, ETH Zurich

Photodegradation, an important abiotic degradation process, is rarely considered in Product Safety and Regulatory Affairs. In this study, we also investigated the influence of smectite hydration status on the transformation of indole in Montmorillonite as well as the pH and the type of exchangeable cation present on Montmorillonite. Based on our results...
In this paper solubilization of persistent organic pollutants, PAHs, PCBs, pesticides and emerging pollutants, as PBDEs or PCN, was investigated in water samples, using some anionic, cationic and non-ionic surfactants. These pollutants are well known for their considerable toxicity, persistence and bioaccumulation toward both human health and environment in addition to their low aqueous solubility. However, the use of surfactants to water solution enhances solubilization of hydrophobic organic compounds. Above the critical micelle concentration (CMC), surfactants exist as aggregates in solution and hydrophobic compounds move to hydrophilic micellar core region. This technique was used as an alternative method to traditional liquid-liquid extraction with hexane. The physical and chemical properties as size, shape, ionic strength and hydrophobicity are important to identify the appropriate surfactant depending on the type of compound to be removed. The method consists in two steps: a) removal of analytes from aqueous solution by the micelles; b) mobilization of the organic solvent followed by micellar deformation with addition of NaCl. Both steps are effective, easy and with high recovery of pollutants. Furthermore, the samples are already in the solvent for quantitative analysis. The removal of analytes from aqueous solution was verified by comparing UV-Vis spectra in the range 240-360 nm before and after extraction in isooctane and then, has been quantified with capillary-gas-chromatography-triple quadrupole mass spectrometry. Results reveal better extraction by micelles than traditional method, mostly more interesting are binary system of surfactants, i.e. cationic-nonionic, anionic-nonionic. It was found that solubilization of analytes increases with increasing hydrophobicity of surfactant. Therefore, the aim of this study is to improve this method comparing solubilization capability of these surfactants based on different number of ethylene oxide units in nonionic surfactants tail groups, and number of hydrophobic groups in cationic and anionic surfactants in order to optimize recovery of pollutants and minimize the quantity to be used in environmental monitoring programs.

**WE070 Water Treatment - A Regulatory Challenge under Regulation (EC) No 1107/2009**

F. Schmidtler, S. Dorn, J. Wilbauer, Dr Knoll Consult GmbH

Regulation (EC) No 1107/2009 aims to protect humans and the environment and lays down rules for the authorisation of plant protection products in commercial form and for their placing on the market, use and control. Plant protection products consist of or contain active substances, i.e. the molecules or materials responsible for the action against the target pest, weed or fungal. Ozonation and chlorination are primary disinfection processes for central water treatment. Metabolites of certain active substances were found to react during ozonation of drinking water and to form by-products with toxic, carcinogenic and genotoxic characteristics. During the approval process of active substances, data-gaps have recently been identified by EFSA regarding Article 4, 3(b) of Regulation (EC) No 1107/2009: A plant protection product shall have no immediate or delayed harmful effect on human health... directly or through drinking water (taking into account substances resulting from water treatment)... In contradiction, water treatment processes are not implemented in the data requirements (Reg. 283/2013 or 284/2013) and no guidance documents for non-experimental tail-gaps and primary disinfection points. The conclusions of active substances submitted under the 3rd group of the Annex I Renewal Programme (AIR3) are evaluated for different applied ways of addressing ozonation and chlorination during the registration process. A statistical overview of the results shows whether water treatment processes have been addressed successfully. An overview of these regulatory challenges is provided with intermediate recommendations to address water treatment processes for active substance approval.

**WE071 The identification of persistent, mobile, toxic (PMT) chemicals as SVHC based on their equivalent level of concern to persistent, bioaccumulative, toxic chemicals defined in Article 57(f) of REACH**

S. Hale, Norwegian Geotechnical Institute; H. Amp, NGI / Environmental Technology; L. Vierke, German Environment Agency / Chemicals; M. Neumann, German Environment Agency (UBA) / Section IV 2.3 Chemicals

The identification of polychlorinated biphenyls in top predators nearly 50 years ago led to the establishment of many environmental chemistry regulations and chemical regulatory frameworks directed towards persistent, bioaccumulative, toxic (PBT) or a very persistent, very bioaccumulative (vPvB) chemicals. In order to protect human and the environment, additional physico-chemical properties to PBT and vPvB may be relevant to consider. Mobility is one of these additional properties and persistent, mobile, toxic or very persistent very mobile compounds are commonly the problematic ones. When mobility and the toxicological hazard is high, the prior steps of the REACH and registrants/manufacturers are not obligated to carry out an assessment of mobility. Here we present a case for the consideration of PMT and vPvM as substances of very high concern (SVHC) based on their identification through
article 57(f) of REACH based on a demonstrated equivalent level of concern (ELoC) as PBT or vPvB substances. In order to identify PMT as a substance of concern. It is demonstrated that the potential EFSA believes that the unequivocal scientific evidence. The focus of this poster presentation will be on the fluorotelomer-based products of the PFAS group with six or less fluorinated carbons (“short chain”). Fluorotelomer-based products can be either the polymeric or non-polymeric PFAS categories. Within the polymeric PFAS category, the fluorinated repellent products, including durable water repellents (DWRs), are found. These are normally side-chain fluorinated polymers typically applied in combination with other finishing auxiliaries. The side-chain polymeric fluorotelomer-based products perform exceptionally well and provide flammability and critical properties on high-end performance garments, workwear, first responder gear and a wide range of other high end performance garments. Within the non-polymeric fluorotelomer-based products provide superior surface wetting and leveling properties in many end-use applications, while the accumulation of related compounds are able to accumulate in a closed loop system. vPvB can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

WE072

How many vPvM/PMT substances have been registered under REACH? - vPvM/PMT screening by using the Danish QSAR database

R. Holmberg, Danish EPA / Chemicals; E.B. Wedebey, N.G. Nikolov, Technical University of Denmark (DTU) / Division of Diet, Disease Prevention and Toxicology, DTU Food; K. Tyle, DK EPA / Chemicals

UBA, Germany, has initiated work to develop criteria to identify substances which are very persistent and very mobile (vPvM), and persistent, mobile and toxic (PvM/PMT) based on their capacity to reach and to accumulate in semi-closed drinking water cycles, while bioaccumulative compounds are able to accumulate in a closed loop system. vPvB can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

WE073

Identifying PMT substances amongst REACH registered substances

H. Amy, NGI / Environmental Technology; S. Hale, Norwegian Geotechnical Institute; A. Striffler, denkbares; D. Sättler, UBA / Section IV Chemicals; L. Schlieben, UBA; M. Neumann, German Environment Agency (UBA) / Section IV 2.3 Chemicals

The chemicals that have the greatest chances of appearing in drinking water are those that are mobile in the aquatic environment enough to enter drinking water sources and persistent enough to survive water treatment processes. Despite the growing interest in the issue, regulatory authorities relating to groundwater protection have given little consideration as to how to identify or categorize which of them are persistent, mobile and toxic (PvM/PMT) and thereby pose a potential threat to drinking water. In the list of REACH registered substances as of May 2017 was independently evaluated for their likelihood of being a PMT. The evaluation of persistent (P), very persistent (vP) or potentially persistent (i.e. Pscreen) was performed according to REACH guidelines. For mobility, a criteria of a measured (or estimated) log Koc value of >64 is used.

WE074

Recent Advances in Toxicology, Safer-Alternative Assessments, Value-In-Use and Best Practice Guidance of Short-Chain Fluorotelomer-Based Products for AFFF, Textiles and Other End-Uses

S. Korzeniowski, BeadEdge Consulting; J. Bowman, FluoroCouncil

Per- and polyfluoralkyl substances (PFAS) is a term that describes a wide and diverse array of chemistry containing fluorine and carbon. The focus of this poster presentation will be on the fluorotelomer-based products of the PFAS group with.

WE075

LIFE project PHOENIX: a new project for the management of water pollution from short chain perfluoralkyl acids in Veneto region (Italy)

F. Russo, M. Vazzoler, V. Groppi, Region Veneto, Direzione Prevenzione, sicurezza alimentare, veterinaria; F. Zanoni, F. Da Prà, R. Lava, M. Mazzola, G. Onofrio, L. Da Rugina, ARPA Veneto; M. Bonato, University of Padua, Department of Biological and Environmental Protection; F. Fossati, University of Padua, Department of Biological and Environmental Protection; C. Tozzi, University of Padua, Department of Biological and Environmental Protection; L. Tallandini, University of Padua, Department of Biology; M. Carrer, L. Palmeri, University of Padua / Department of Industrial Engineering; N. Tormen, University of Padua, Department of Biology; S. Valsecchi, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; S. Pololessolo, Water Research Institute- CNR / Water Research Institute

In 2013 a significant episode of PFAS pollution from surface-ground- and drinking water has been discovered in a large area of the Veneto region, in Northern Italy. The most important source of pollution was identified in a fluoroochemical plant, sited in an area of groundwater recharge. The Veneto Region immediately put in place mitigation actions that were more effective for long chain PFAS than for short chain ones. For that reason, within the framework of the Community Life Program (ELoC as PBT or vPvB substances can be managed).

WE076

Ecotoxicological characterization of aquifers at Junin Formation and Pampeano from Hydrogeological Sub-Region II, Buenos Aires Argentina

W.D. Di Marzio, CONICET PRIET UNL; A. Silva, UBA Fac Cs Exactas; G. Galussa, Universita Laquila; T. Di Lorenzo, ISE CNR

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WE077

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The Groundwater of Hydrogeological Sub-Region II at Buenos Aires province, is well characterized from a physico-chemical perspective. Until today is well established that fluoride and arsenic are the main concerns related with the potential use as source of drinking water. However, an ecosystemic perspective that focus on their invertebrate communities and the ecotoxicity potential is missing at least in this subregion. In this work we showed the preliminary results obtained after the sampling and analysis of ten on 20 total wells projected to be evaluated. This area is known as Junín Formation, which consists of sandy aquifer deposits and silts of reddish brown to light brown color, very friable, and with scarce calcareous bodies of pedogenic origin. The Junin Formation of wind constitutes an alternation of low elevations and depressions. Aeolian sediments, which belong to the Junin Formation (Aeolian Platine), normally do not exceed 5 m in thickness and prevailing have calcareous (coarse) levels. The alluvial and colluvial deposits (sandy silts, sands, gravels and blocks) have a reduced vertical and areal expression. The samples were characterized according their main anionic and cationic constituents, presence of glycophosphate and chlorophyll, TOC, arsenic and fluoride. Also, cyto and genotoxicity of concentrated waters were studied by comet assay using coelomocytes of Eisenia fetida. Water quality was analyzed in combination with the dominant taxon of invertebrates founded. They were mainly copepods, Acari, Colembola, Insecta, Oligochaeta, Nemata. A preliminary biotic and ecotoxic index were created to characterize each sampling well.

WE077

Chemical analysis, monitoring and toxicological evaluation of very polar compounds in drinking water and drinking water sources

R. Sriprat, KWR Watercycle Research Institute / Chemical Water Quality and Health; P. Kooij, KWR Watercycle Research Institute; K. Baken, KWR Watercycle Research Institute / CWG; A. Kollman, KWR Watercycle Research Institute; P. de Voogt, University of Amsterdam / IBED

Very polar organic compounds are of special interest for drinking water utilities, since these substances are likely to end up in drinking water. The distribution of persistent and mobile compounds in the urban water cycle is widespread since they can leach to groundwater and pass wastewater and drinking water treatment. Currently there is an analytical gap, a monitoring gap and a lack of toxicity data. Here we analyzed a large number of very polar and mobile compounds (PMOC) by GC-MS in order to close these gaps. Very polar and mobile compounds were detected in wastewater, surface water and drinking water in the Netherlands and Flanders. In addition, water samples from various other sources, such as surface water, groundwater, river and lake water were analyzed. The persistent compounds showed a widespread distribution, whereas many of the mobile compounds were detected only in certain sources. This indicates that not only the sources, but also the fate and removal mechanisms in water treatment processes play a role in the distribution patterns of these compounds. The results showed that very polar organic compounds are present in drinking water and that their detection and monitoring may play an important role in assessing the quality of drinking water.

WE078

Beyond DEHP: High-molecular-weight phthalates and non-phthalate plasticizers in German Rivers

R. Nagotka, Federal Environmental Agency (UBA) / Water and Soil; J. Koschorreck, Umweltbundesamt

The phthalate plasticizer Di(2-ethylhexyl) phthalate (DEHP) is a well-documented ubiquitous contaminant and frequently regarded as the predominant plasticizer in the environment. The use of DEHP and other phthalates was banned in the EU because of their endocrine-disrupting activity. As a result, the production of these phthalates decreased significantly. In contrast, the global plasticizers demand is continuously growing. Market data show that high-molecular-weight phthalates are now extensively substituting DEHP together with various types of non-phthalate plasticizers. Previous investigations on plasticizers in the aquatic environment have largely focused on DEHP and selected low-molecular-weight phthalates. However, little is known about the presence of other phthalates and non-phthalate plasticizers. In contrast, there is increasing evidence on the occurrence, fate and effects of these alternative plasticizers in the environment. The objective of this study was to obtain spatio-temporal trends for DEHP and its substitutes in freshwater systems. We analyzed suspended particulate matter samples (SPM) for the presence of 23 plasticizers, i.e. 17 phthalates and 6 non-phthalates. Samples from recent years were collected from the German Environmental Specimen Bank (EBS), which covered 16 sampling sites from major rivers including Rhine, Elbe and Danube. Retrospective trend monitoring with archived ESB samples that were collected over the last decade enabled trend assessment for DEHP and its non-regulated substitutes. Today, the high-molecular-weight-plasticizer Diisononyl phthalate (DINP) is the most abundant plasticizer detected in the SPM-samples. Our results indicate a fast appearance of new plasticizers like Diisooctyl phthalate, Diisononyl cyclohexan-1,2-dicarboxylate (DINCH) in freshwater environments and we identified several compounds, for instance Di(2-propylheptyl) phthalate (DPHP), as potential chemicals of emerging concern with increasing levels.

Wastewater effluents: How research can improve risk assessment and regulation (P)

WE079

Acute and chronic toxicity of Direct Blue 15 on microalgae and cladocerans: a comparative study

M. Hernández Zamora, Escuela Nacional de Ciencias Biológicas-I.P.N / Laboratory of Experimental Hydobiology; F. Martínez-Jerónimo, Escuela Nacional de Ciencias Biológicas-I.P.N / Laboratory of Experimental Hydobiology

Aquatic pollution resulting from industrial activities, especially textile, leather, food and agrochemicals, is a major concern. Dyeing process of fabrics produces approximately 90% of the total textile wastewaters, containing significant concentrations of residual dye molecules. Colored wastewaters reduce light penetration in the water column, and affects photosynthesis of phytoplankton. In addition, azo dyes are synthesized from carcinogenic compounds, such as benzidine; this can threaten the aquatic biota. The environmental impact caused by the discharge of textile dyes effluents has been scarcely studied; therefore, our study was aimed at evaluating the toxic effect of the azo dye Direct Blue 15 (DB15) on a primary producer (Pseudokirchneriella subcapitata) and on a primary consumer (Ceriodaphnia dubia). The microalgae was exposed to 4, 8, 16, 32 and 64 mg L⁻¹ DB15 (96 h, 25°C, and continuous illumination of 120 μmol m⁻² s⁻¹); the effects of DB15 on photosynthetic pigment and macromolecules content (proteins, carbohydrates and lipids) were assessed. The acute toxic effects of DB15 dye in cladocerans were determined at 48 h; tested concentrations were 100, 200, 400, 500 and 1000 mg L⁻¹ at 25°C, 16:8 h photoperiod, with no food supply during the assays. In chronic toxicity tests C. dubia individuals were exposed to 5, 10, 15, 20 and 25 mg L⁻¹ DB15 (7 days at 25°C, 16:8 h photoperiod, 1x10⁶ cell mL⁻¹ of P. subcapitata as food). P. subcapitata was more sensitive to DB15 (LC₅₀ values 13.0 mg L⁻¹ than C. dubia (LC₅₀ 450 mg L⁻¹)). Chlorophyll a and b were significantly increased in the algae exposed to all the dye concentrations, comparing with the control, but carotenoids were significantly reduced in all the DB15 concentrations. Concentration of proteins, carbohydrates and lipids per cell in P. subcapitata exposed to all DB15 concentrations were significantly higher than that measured in the control. In the highest DB15 concentrations, total progeny, number of released clutches, and reproduction were significantly decreased in C. regaudii; but age at first reproduction was significantly increased at 20 and 25 mg L⁻¹ DB15. Results demonstrated that DB15 dye caused toxic effects of different magnitudes on aquatic biota (primary producer and primary consumer), for this reason, the azo dyes must be regulated to prevent environmental impacts caused by the discharge of textile dyes into water bodies.

WE080

Integrated biomarker response calculation as a useful tool to assess the impact of effluents on the health status of fish

S. Wilhelm, University of Tuebingen / Animal Physiological Ecology; S. Jacob, Universität Tübingen / Animal Physiological Ecology; M. Ziegler, R. Triebskorn, University of Tuebingen / Animal Physiological Ecology

Impact of effluents on aquatic ecosystems can be assessed by monitoring several types of biomarker endpoints, such as physiological, biochemical, and ecotoxicological parameters for the biota (primary producer and primary consumer). The environmental impact caused by the discharge of textile dyes effluents (WWTPs) is considered as one of the major sources of micropollutants in the aquatic environment. Many compounds have been linked to toxic and endocrine effects in aquatic organisms. The present study examines the impact of three WWTPs situated on different streams in Southern Germany on the health status of fish. Two reference sites and two WWTP effluents were investigated. Fish were exposed in cages upstream and downstream of each WWTP effluent. Further, the impact of the WWTP upgrade with activated carbon was investigated by comparing results of caging exposures conducted prior and subsequent to the upgrade. Several biomarkers, including histopathological alterations, the formation of microcysts and micronuclei, changes in vitellogenin levels, induction of hepatic EROD activity, and changes in stress protein levels were examined, and the integrated biological responses (IBR) were calculated for the downstream exposure sites according to Sanchez et al. (2015), using the respective upstream site as a reference. IBR values for the conventional treatment plants (WWTP 1 and 2) differed slightly from each other, with WWTP 2 showing three to five times higher indices than WWTP 1. However, the highest IBR values were detected for male fish exposed downstream of the third WWTP prior to the upgrade with an activated carbon filter unit. After the installation of the additional treatment technology, a pronounced reduction of IBR values could be observed. The IBR biomarkers proved to be a suitable approach to assess the impact of WWTP effluents on the health status of fish. Furthermore, it was a helpful tool to reveal the advantages of WWTP upgrading with powdered activated carbon.
Pharmaceutical compounds in sewage effluents pollute the aquatic environment and may adversely affect fish populations. Conventional sewage treatment plants (STP) are not equipped to efficiently remove pharmaceuticals. Ozonation is emerging as a method to improve sewage treatment. Ozonation can however potentially create toxic by-products (OBPs) that may have deleterious effects on fish. In this study we screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP using a full scale parallel ozonation line to investigate endocrine, reproductive and behavioral effects in fish and its progeny exposed to the conventional STP effluent. Furthermore, we sought to elucidate if any such effects were either abated or amplified by effluent ozonation (7 mg O₃/L). We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 dark/ light cycle) in constant illumination, in triplicate, in re-circulating tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformations and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. However, on the contrary to our assumptions, the biological effect screening revealed male liver VTG-2 gene expression, a marker of estrogenic endocrine disruption, was induced by the ozonated effluent. This indicates that ozonation possibly created estrogenic OBPs. Furthermore, the ozonated effluent fortified with organic and a two specific compounds in effluent. A second ozonation treatment (UV/H₂O₂) through tests with angula seeds (Eruca sativa) and Artemia salina. Samples of secondary effluent from a pilot plant located at the School of Technology campus (UNICAMP, São Paulo, Brazil) were collected immediately after the secondary treatment and then they were treated and analyzed in triplicate. The biological reactor was a hybrid: septic tank - anaerobic filter. After collection, 200 mL of each sample was dechlorinated and filtered to the laboratory and stored at 4°C. Based on the preliminary tests it can be concluded that the secondary effluent treatment by UV/H₂O₂ in presence of high concentration of metals, nitrate, carbonate and industrial contaminants has no significant increase on toxicity.

**WE085**  
Hospital effluent induced oxidative stress on Xenopus laevis larvae  
J. Pérez-Alvarez, Universidad Autónoma del Estado de México / Environmental Toxicology; H. Islas-Flores, Universidad Autónoma del Estado de México / Toxicología Ambiental; L. Gómez-Olíván, Universidad Autónoma del Estado de México / Farmacia; M. Galar-Martínez, Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas; N. SanJuan-Reyes, Autonomous University of the State of Mexico / Chemistry.

Hospitals are one of the main sources of emerging pollutants to wastewater treatment plants (WWTP) that usually are fairly equipped to treat this kind of compounds. Activities performed in hospitals require the use of several compounds, which are potentially toxic, they can reach municipal wastewater treatment plants. As a result, the procedure carried out in this WWTP is not able to remove all the contaminants, when they are not properly disposed, exposure to them can generate harmful effects on aquatic organisms. Physicochemical and pharmaceutical (11 pharmaceuticals) characterization of the hospital effluent were made, results shown a high concentration of mercury, and pharmaceuticals on concentrations of µg/L. Also oxidative stress was evaluated on Xenopus laevis larvae exposed to this hospital effluent; twenty oocytes were selected for each exposed group (control, 0.1, 0.3, 0.5, 0.7, 0.9 and 1%). In the middle blast stage, they were maintained at constant temperature 23 ± 2°C, for 96 hours until they reached the larval stage. They were
weighted, homogenized and centrifugated for the determination of hydroperoxides, lipoperoxides, carbonated protein content, and the antioxidant activity of superoxide dismutase and catalase, results shown statistically significant increments regarding control group in all the biomarkers evaluated, thus indicates that the hospital effluent tested in this work can generate oxidative stress on * Xenopus laevis* larvae, based on the results obtained, hospital effluents can generate oxidative stress in other species and due the lack of appropriate WWTP hospital effluents can represent a risk for aquatic organisms.

**WE086**

An assessment of (anti-)androgenic activity in sludge from a rain spillway basin of the WWTP Aachen Soers as well as in sediments from the catchment area of the recipient water, the river Wurm

K. Schröder, RWTH Aachen University; A. Shuliakievich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; Y. Müller, RWTH Aachen University / Institute of Environmental Research; S. Holz, RWTH Aachen University / Institute for Environmental Research; S. Schiwy, RWTH Aachen University / Department of Ecotoxicology Analysis; H. Holter, RWTH Aachen University / Institute for Environmental Research

Hormonally active micropollutants (MPs) are a well-known problem in aquatic environments. They can severely alter entire ecosystems by disrupting the endocrine system of its organisms. Adverse effects can extend to invertebrates and vertebrates including humans. As many MPs cannot be completely eliminated during conventional treatment in municipal wastewater treatment plants (WWTPs), they enter the recipient waters. So far, mostly the effects of estrogenic active compounds have been investigated. However, a crucial part of the occurring hormone-equivalents is formed by androgen receptor inhibiting or activating compounds. Thus, the scientific attention has increased to account for their importance. Due to their strong lipophilicity, the main part of these compounds accumulates in sediments in raising tool to induce endocrine-disrupting MPs is the implementation of an additional treatment step like ozonation. Within the DemÖAC Project, the WWTP in the catchment area of the river Wurm in Aachen Germany will be equipped with a large-scale ozonation. It is unknown how the concentrations of (anti-)androgens in sediments will be altered by this new treatment step. Up to now, controversial results were published regarding the elimination of (anti-)androgens by ozonation in effluents. Furthermore, sediments were rarely studied. To fill this scientific gap, this study will evaluate the status quo of (anti-)androgenic potentials in sediments and samples from the WWTP before the implementation of the ozonation at the WWTP in 2018. Investigation of samples from a rain spillway basin was conducted to measure the potential endocrine impacts of rain during a heavy rain event. Additionally, a sewage sludge sample was tested, to gain more information. Assessment of (anti-)androgenic activity was performed by testing sample extracts using the (anti-)AR-CALUX® assay. These studies will be conducted associated to the DemÖAC Project as part of an exploratory study. First results revealed an androgenic potential as well as cytotoxicity in the highest concentrations of the samples. The full depiction of the (anti-)androgenic activity in the catchment area of the Wurm will be available at the time of the conference.

**WE087**

Processes underlying the environmental fate of pharmaceuticals in the Nairobi River Basin “impact zone”: implication for environmental risk assessment

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Recent investigations have highlighted the widely-spread occurrence of active pharmaceutical ingredients (APIs) in African water bodies. Wastewater (treated or otherwise) is the main source of APIs to the environment and identified heavily contaminated areas have been ascribed to the poor African wastewater treatment facilities (WWT). The formation of so called “impact zones” is severe in urban areas characterized by informal settlements with little in the way of wastewater treatment. The Nairobi River (NR) is an example of such contaminated areas. The wastewater generated from the city’s informal settlements and the insufficient WWTP is directly discharged in the Nairobi River basin leading to a large-scale “impact zone” characterized by occurrence of high levels of ammonia, biochemical oxygen demand and low dissolved oxygen and commensurately elevated levels of APIs. Also, the presence in this area of industrial wastewater discharges from pharmaceutical factories also contributes to the occurrence of APIs. Hitherto, the published investigations provided evidence of APIs occurrence at concerning concentrations, but little is known about the processes underlying the E-fate of such contaminants. Processes such as distribution to suspended solids, colloids and dissolved organic matter, the quality of these sorbents, and the ability of the biodegrading bacteriological community to adapt to and degrade a contaminant are key in determining its E-fate. The impact zone generated by sewage and industrial wastewater together with the local natural sorbents abundance influences the APIs distribution and E-fate. Data will be presented on sorbent concentration and quality related to distribution processes of APIs in the impact zone and the individuation of eventual bacteriological community shifts as an effect of the direct discharge of untreated wastewater loaded with APIs. In addition, since preliminary studies on the biodegradation of the antiretroviral nevirapine, commonly used in Africa, has showed persistency (similarly to studies on the antiepileptic carbamazepine in Western countries) the occurrence of nevirapine will be studied to test its suitability as indicator of sewage pollution in African river bodies. The implementation of a study, this study contributes to the development of a methodology for the determination of the impact zone spatial boundaries and a dedicated environmental risk assessment approach for APIs in the impact zone.

**WE088**

Occurrence of pharmaceuticals, metabolites and transformation products from combined sewer overflows in London measured by high resolution targeted, suspect screening and untargeted chemical analysis

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Combined sewer overflows (CSOs) are controlled releases of raw, untreated wastewater to a river during times of heavy rainfall to avoid back-flushing of buildings and streets. The impact of CSOs on a river catchment with respect to pharmaceutical residues is not well understood. In London, CSOs occur ~12 times per week as its Victorian sewer network struggles to cope. Here, a temporal study of the River Thames is presented to identify CSO-related occurrence of pharmaceuticals, including metabolites and transformation products. Daily samples of river water, influent and effluent wastewater were analysed using a validated method involving solid phase extraction (SPE) and liquid chromatography and high resolution accurate mass spectrometry (LC-HRMS). The work was divided into four parts: (a) the identification of CSO markers based on the determination of 30 pharmaceutical/metabolite occurrences in influent and effluent wastewater; (b) determination of CSO markers in receiving river water over a six-week period; (c) suspect screening to identify metabolites/transformation products; and (d) classification of samples using untargeted data analysis. By differentiating influent and effluent, CSO markers were identified including caffeine, bezafibrate, benzoylegoline and furosemide which were present in influent at relatively high/consistent concentrations. Following this, targeted analysis of the River Thames samples revealed that CSO marker concentration increased mainly during wet periods where the tide was low. A further 14 compounds were also determined to observe any ‘dilution effects’ related to CSO occurrence. This was evidenced by a decrease in pharmaceutical occurrence of known metabolites/transformation products is also presented for a selection of compounds via machine learning prediction of LC retention times and mining of HRMS data [1]. Finally, untargeted analysis revealed that river samples could be differentiated based on climate and/or tide height using principal component analysis and volcano plots. The use of several different modes of data analysis have highlighted the need for a better understanding of complex occurrence data potentially influenced by timed CSO events. [1] K Munro, TH Miller, CBP Martins, AM Edge, DA Cowan, LP Barron, J. Chromatogr. A, 1396 (2015) 34–44

**WE089**

Occurrence, fate and bioactivity of pesticides in wastewater

V.V. Yargeau, McGill University / Chemical Engineering; P. Westlund, D. Nasaboughi, S. Isazadeh, McGill University

Unlike for contaminants of emerging concern (CECs), data available for the occurrence, fate and bioactivity of pesticides (herbicides, fungicides, and insecticides) in wastewater treatment plants (WWTPs) is limited. Our research showed that of the 18 compounds investigated only imidacloprid, was not detected at the three WWTPs included in the study, confirming that municipal wastewater discharges contribute to the presence of pesticides in the aquatic environment. Using a suite of bioassays (high-throughput bioluminescence assay using the target species Vibrio fischeri, yeast estrogenic screen (YES) and yeast androgenic screen (YAS)) we investigated the effects of samples as wastewater effluents treated using secondary treatment or ozonation was investigated. It was found that of the 12 pesticides showed either antiestrogenic or antiandrogenic activity and 7 compounds showed pleiotropic effects. This study was first to confirm endocrine activities based on yeast-based assays of recent neonicotinoids. The use of extended time points for the *Vibrio fischeri*, beyond the traditional 30 minutes, highlighted the necessity for some compounds was underestimated using only the acute test. Using a structure-activity relationship approach similar to the one used in hazard assessments, the relationship between toxicity and key physicochemical properties of the pesticides was investigated and trends were identified. This work also provided novel knowledge on the removal of some fungicides (climbazole, myclobutanil and tebuconazole) by ozonation and demonstrated the recalcitrant nature of pesticides during ozonation. This study is one of the first to investigate androgenic activity during the ozonation of a mixture of pesticides and an increase was reported. These findings further demonstrate the importance of combining bioanalytical tools to analytical chemistry in the evaluation of wastewater quality
and treatment performance.

WE900 Fate of perfluoroalkyl substances within a small stream food web affected by sewage effluent
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Within our experiment, the fate of fourteen PFASs was studied in an ecosystem of a small stream affected by STP’s effluent. The unique field experiment design was carried out to allow long-term study focused on bioaccumulation of PFASs in indicator organisms and their ability of adaptation to the polluted environment. Two hundred brown trouts (Salmo trutta) originating from clean site were recaptured after one, three, and six months they spent in the environment affected by the effluent of that local STP. Besides the fish stocked into the polluted locality from the clean site, also fish originally inhabiting the downstream locality and macroinvertebrates from both sites were sampled and analysed. Passive sampling approach using polar organic chemical integrative samplers (POCIS) was applied to determine occurrence of PFAS in water soluble fraction over the course of the experiment instead of conventional grab water samples. Twelve of the fourteen target PFASs were found in concentration above the LOQ in at least one of the water samples from downstream locality while only three were present in samples from clean site. The compound pattern varied significantly between fish species of macroinvertebrates, and POCIS indicating several exposure pathways leading to bioaccumulation of PFASs in fish body. Concerning the accumulation of PFASs in fish, the highest concentrations were found in the liver of individuals sampled after three months of exposure. These concentrations rapidly decreased after six months although there was no significant change in occurrence of PFASs in water during the experiment. Such finding can be linked to both increase of water temperature leading to higher enzymatic activity and adaptation of studied fish to the polluted environment. Based on our results we also suggest that the process of adaptation might be related to the gender of fish as we found significantly higher occurrence of PFASs in males in comparison to females. Acknowledgements: The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic - projects "CENAKVA" (No. CZ.1.05/2.1.00/01.0024) and "CENAKVA II" (No. LO1205 under the NPU I program) and by the Ministry of Agriculture of the Czech Republic (NAZV “KUS” No. QI1530120).

WE901 Patterns of natural and human-made interacting processes on source, transport and fate of trace metals in the Adriatic Sea basin
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The Adriatic Sea has been under intensive influences of human activities, which are pressuring the marine ecosystems as a whole. The morphology of this land-locked marginal sea and the intensity of human pressure on its coastline influence enhances metal excess and concentration in the sediment cores from the Adige prodelta down to the Gargano, which has been mainly related to the environmental regulations enforced by governments. Finally, the main transfer process of trace metals from coastal waters to the open sea is attributed to the cascading of the North Adriatic Dense Water (NADW) in deep sea areas of the southern Adriatic, which would be able to quickly transfer suspended sediments (and, therefore, particle-binding contaminants) during episodic events and supports the inference that this region may act as the final repository for contaminants within the Adriatic Sea.

WE902 Photocatalysis as a potential pre-treatment process to reduce organic pesticide entries
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For protecting their crops many wine growers apply plant protection products (PPPs), which may accidentally end up in the aquatic environment e.g. after being washed off from agricultural machinery (AM). Once there, PPPs can negatively impact aquatic life which are often irradiated by UV light. This is a problem related difference in the degradation potential of TiO2 photocatalysts (Aeroxide P25 and Hombikat UV100) by separately and simultaneously treating five different PPPs in aqueous solution under artificial UV irradiation (UVA: 40 W/m²) for 60 min. The pesticides were chosen as representatives, being frequently used for viticulture in the Triunfador Uno River Area, a region where wine growing is one major form of agriculture. To evaluate product dependent efficiencies of TiO2 based photocatalysis, treated and untreated PPPs were analyzed for remaining PPP concentrations and major metabolites before an additional TiO2 × UV treatment. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO2 to reduce PPP concentrations and associated toxicity in water after being irradiated by UV light. Further, a product related difference in the degradation potential of TiO2 for the selected PPPs was observed. However, for a final statement whether TiO2 can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.

WE903 Study of the efficiency of removal of organic load and generation of energy through a bioelectrochemical system coupled to a constructed wetland
Due to the progressive use of agrochemicals for energy generation through the degradation of industrial and domestic effluents using electroactive microorganisms, these systems coupled to build wetlands (BES/CAW) acquire the capacity to treatment effluents of various kinds. Although several studies have been developed to evaluate the efficiency of these systems for chemical oxygen demand (COD) removal and energy generation. To this aim, it was implemented two plastic containers with a volume of 20 L and an operating volume of 0.96 L, packed with river gravel and planted with phragmites sp., carbon felt was used for the construction of anode and cathode, both with a surface of 0.72 cm². The distance between both electrodes was 6 cm without proton exchange membrane, both electrodes were connected by a resistance of 1000 Ohms. The feeding was performed by gravity applying four pulses of 1.5 L/h, using synthetic water whose composition was similar to data reported by Yadav et al., (2012). The effect of two types of contaminants was evaluated azo dye (AD) and alkylphenols (AP), the voltage measurements were made daily after 20 days of operation, the time necessary for the development of the biofilm (from 9:00 h in intervals of 2h). The
COD measurement was performed weekly on the influent and effluent of both systems. After 40 days in operation, the systems showed voltage average values of 673 and 580 mV, maximum current densities of 20.8 and 37.5 mA/m², and COD removal of 38.5 and 36.71% for effluents AZ and AP, respectively. A significant increase in the current density was observed in the measurements taken after 13:00 h, which shows an effect of temperature on the generation of voltage and therefore current flow in the system. The results obtained represent a sustainable option for the generation of energy from domestic waters from secondary effluents, which would not only improve the quality of the water before being discharged to the receiving bodies but also take advantage of the high concentrations of nutrients contained in these wastes.

WE094 Adsorption of Crystal Violet from Quaternary Basic Dye Mixture onto a Sawdust-Based Adsorbent

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Wastewaters from textile and other dye-using industries usually contain more than one dye. In such an aqueous matrix therefore, the adsorptive characteristics of a dye species are likely to be affected by the presence of the other dye species in the medium. The removal of crystal violet from aqueous solution by sulphuric acid treated sawdust and Laccase modified sawdust is investigated in this study. The influence of malachite green, gentian violet and rhodamine B on its adsorption from binary, ternary, and quaternary dye systems were studied. The combined effect of mixture components and process parameters on the adsorption was studied and optimized using response surface methodology. The adsorbent was characterized and the experimental data obtained were fitted to different kinetics and isotherm models. The experimental results were analyzed using the ANOVA statistical analysis software. The optimum contact time, pH, adsorbent dose and temperature were found to be 275.10 min, 9.94, 0.99 g and 60 °C respectively for the maximum decolourisation of 68.39 mg/L CV (97.2%). A linear model was obtained for the decolorization process through this design. The experimental values obtained were in good agreement with the predicted values, and the model developed was highly significant, with correlation coefficient of 0.985. The adsorption in all the dye systems investigated followed Freundlich isotherm, and the maximum monolayer adsorption capacity was between 18.87 - 24.39 mg/g, depending on the composition of the adsorbate matrix. The adsorption kinetics was well described by the pseudo-second order model (R² > 0.95). All the eight adsorbate systems investigated were endothermic (ΔH positive; 35.30 to 43.61 kJ/mol), thermodynamically feasible (G < 2.30 to -6.13 kJ/mol) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment

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Discharges from wastewater treatment plants (WWTPs) are a source for pollutants to the environment. Here we studied influent patterns and removal of selected elements in two Norwegian WWTPs. Ladehammeren (LARA) is a treatment plant in Trondheim, Norway. Both WWTPs have significant industrial loading contributions (up to 40% in LARA), employ preliminary and primary treatment steps, including chemically aided flocculation (CIFeO₂S/polyamine in LARA, polyacrylamide in HØRA), and discharge directly into Trondheimsfjord. In a 7 day sampling campaign, 24 h composite samples of influent and effluent wastewater, as well as sludge samples, were taken to determine influent concentrations and removal of Al, P, S, Cr, Fe, Ni, Cu, Zn, As, Cd and Pd. To study release patterns and gain information about potential sources, diurnal variations of elemental concentrations were determined and modelled in 8 h composite samples of raw influent wastewater from morning, evening and night discharges. Element concentrations in the influent were highest for Al and lowest for Cd < As < Cr and Pd. Concentrations of Al, Cr, Cu and Cd were higher in HØRA than LARA, with Fe loadings being approximately double. Removal efficiencies varied between the analysed elements, and were highest for Al (86%), P (74%) and Cu (57%) in LARA, which utilises both inorganic and organic flocculants. In contrast, removal rates were below 50% for P, Cu and S in HØRA. Herein, in LARA concentrations of Fe, Ni and S were significantly higher in the treated effluent compared to the raw influent, deriving from the use of inorganic flocculant. This was also reflected in Fe and S concentrations in treated sludge. Elemental concentrations in 8 h composite samples mostly followed general diurnal discharge patterns, with higher concentrations in mornings and evenings and lower concentrations at night. In HØRA, concentrations of most elements further correlated well with total suspended solid concentrations (TSS), with the strongest correlations observed for P, S and Cu (R²>0.9). Correlations with TSS were less pronounced in LARA, and were weakest for Pb, Fe and Cu (R²<0.6), which can be potentially attributed to the higher industrial loading contributions in LARA.

Enrichment factors were high for P>Cu>Zn>Cd>As, and were still above 10 for Cr and Ni in biosolids, indicating anthropogenic sources for these elements. Several elements also occurred as nano- and micron-sized particles.

WE096 Rapid detection of E. coli in wastewater effluent and impact of effluent discharge on riparian invertebrate diversity

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Effluent samples from wastewater treatment plants are expected, due to the treatment processes, to have lower concentrations of toxicants and pathogens than the influent. As such, they are expected to have a lesser impact on the environment than the influent. The aim of this study was to seasonally assess the efficiency of Phuthaditjhaba’s wastewater treatment plant (WWTP) in removing pathogens (E. coli) from its effluent and to determine the impacts of that effluent on invertebrate diversity along the riparian zone of the receiving watershed. Loop mediated isothermal amplification technique was used to screen for the presence of E. coli in effluent samples. There was negative identification of E. coli in the samples collected. Impacts of effluent on invertebrates will be determined by analysing the changes in population dynamics of the invertebrates found in the riparian zone, above and below discharge point of the Wastewater Treatment Plant. At least, 13 morph species of eight insect families have been identified. Taxon diversity will be calculated using the Simpson-Yule Index, from where significant difference analysis would be calculated for environmental variable, species abundances and diversity data. More screening for the presence of E. coli will determine the efficacy of the methodology in determining the presence of pathogens from its effluent. Further identification and presence or absence of invertebrates in the sampled riparian zone will determine if E. coli has any impacts on invertebrate diversity.

WE097 The DemO3AC-project: Chemical and eco-toxicological investigations of the wastewater treatment plant Aachen

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Microplpolunts (MPs) in municipal wastewater, like pharmaceuticals, are not sufficiently removed by conventional cleaning methods in wastewater treatment plants (WWTPs). As a consequence, complex mixtures of MPs discharged into the receiving streams and may cause various effects on the aquatic biota. To decrease the content of MPs into the environment, a full-scale ozonation is implemented into the WWTP Aachen Soers, Germany within the DemO3AC-project. A crucial part of this project is the evaluation of the ecological and chemical state of the receiving stream, the River Wurm. This study focuses on the status quo of this river. To assess the impact of MPs, water samples were taken at 3 treatment steps within the WWTP and at 4 sampling sites (upstream and downstream the WWTP) along the river Wurm. MPs were determined in native samples and extracts. To include various adverse effects a broad test battery was conducted (acute, chronic, mechanism-specific, in vivo and in situ) along with chemical analysis. The analysis of 60 MPs showed mainly the presence of pharmaceuticals and plasticisers/phthalates. In total 52 substances could be detected. A general elimination rate of about 55 % was determined. The toxic potential was high in the WWTP sample and further decreased downstream the WWTP. The DemO3AC project is funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia.

WE098 To use or not to use: sewage overflow dredgings

M.H. Wagensman, Bioclear earth

In a densely populated country like the Netherlands, with a dense sewage system, SETAC Europe 28th Annual Meeting Abstract Book

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many sewage outflows into surface water are present. Sediment located 250 m before and after the overflow needs to be discarded and burnt after dredging while 'normal' sediment can be reused as soil. Discard and burning is expensive for water boards, besides the fact that it costs a lot of energy and causes air pollution due to transportation, which is not sustainable. Also it causes a loss of raw materials. The water board Noordzeerijvest has started a pilot for reused sewage overflow dredgings as new substrates for construction purposes or agriculture. For this purpose two depots have been set up: one with reference sediment and one with overflow sediment. During one year the concentrations of pharmaceuticals and pathogens will be monitored as well as antibiotic resistance and endocrine disruption. The basis of the project is the hypothesis that pathogens will be killed during the process of drying and pharmaceuticals will be (biologically) degraded which makes the use of the soils possible. Results of June 2017 the sediments ESBI (extended Spectrum Beta-Lactamase) measurements. Endocrine disruption will be monitored by means of ER-Calux tests. In the presentation the background of the project will be sketched, then the results of the monitoring up till May 2018 will be presented. Also preliminary conclusions will be drawn and an outlook for reuse possibilities will be given as well as the meaning of the project for other water boards.

WE099 Assessing wastewater processes at oil refinery industry in Kazakhstan
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This paper presents the first attempt to assess the wastewater treatment processes at the oil refinery sector in Kazakhstan and evaluate to what extend these processes follow international and national regulations regarding industrial waste water treatment. The assessment was performed considering wastewater discharge from refinery processes at three factories in the country. While Kazakhstan’s environmental regulation promote the polluter pay principle and follow WHO guidelines, oil refinery factories in Kazakhstan still exceed the permissible concentration of pollutants in discharged wastewater. The national regulation allows discharge of wastewater to natural or artificial ponds by not exceeding the concentration of pollutants already existing in the pond. Therefore, the factories use ponds as a final treatment of pollutants, consequently allowing discharge of high concentration of pollutants (total petroleum hydrocarbons (TPH) exceeds concentration by 30-80 times, ammonia (NH3) by 25 times, total dissolved solids (TDS) by 6 times, biochemical oxygen demand (BOD) by 6 times and surfactants by 5 times) to pond. The reason for the initial high pond concentration is a result of a time gap between the start of pollution discharge by the factories and start of the environmental regulations. This leads to no incentive to treat wastewater in an efficient way. Additionally, the national law lacks regulations regarding detailed methodology to assess the pollutant substances in the discharged wastewater. Thus, the assessment by environmental authorities for each oil refinery is negotiated separately between the factory and the governmental body, giving the factory a strong position to define the parameters assessing the wastewater. As such, none of the factories provides analyses of, e.g., heavy metals in wastewater or organic contamination in discharged wastewater. TPH concentration in wastewater is often exceeded at each factory and there is no analysis done for different hydrocarbon fraction. Consequently, it is strongly recommended to provide a unified and transparent methodology for the country’s oil refinery industry to assess all important pollutants in discharged wastewater and to include all types of hydrocarbon fractions.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health (P)
WE100 Accumulation of Enrofloxacin in the sea lettuce Ulva lactuca
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The Sea lettuce Ulva lactuca is a common species in coastal areas around the world. Its presence in wastewater discharge from fish-farming facilities may lead to the accumulation of antibiotics used in aquaculture. In the present study we followed the accumulation of Enrofloxacin in the sea lettuce Ulva lactuca in seawater and macroalgae discs at several sampling points, after immersion in an Enrofloxacin bath at two different concentrations. These results can help comprehend how MTAs present in wastewater discharge from fish-farming facilities contribute to the environmental resistance. As biota, these organisms are located at the exit point of fishponds or near cages, potentially accumulating pharmaceuticals.

WE101 Antibiotic resistance genes in manure, stored manure and soil after manure application
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Production animal farms are proposed to act as reservoirs where genetic material from manure can be transferred to biota. Animal farms may also transfer certain antibiotic-resistant genes to human and animal-associated bacteria including zoonotic pathogens. In the present study we followed two swine and two dairy farms and quantified ARGs and MGEs with 363 primer pairs using a high-throughput qPCR array. Samples were taken from fresh manure, stored manure, unfertilized soil, soil fertilized with manure, and tile drainage water from ditch, which was sampled before and after land application. We aimed to answer to the following questions: do ARGs disseminate to the environment (field soil and surface waters), are ARGs enriched in stored manure, and are ARG abundances elevated in soils at crop harvesting time. For evaluating the ARG mobility potential, genes related to MGEs were also quantified. DNA was isolated from the soil and manure samples with the PowerSoil DNA Isolation Kit (MO BIO Laboratories). Quantitative PCR reactions were conducted using WaverGen SmartChip Real-Time PCR system. The ΔCt values, ΔΔCt values, relative gene abundances (R), and fold changes (FC) were calculated with R version 3.2.3 and Rstudio Version 0.98. In total 182 out of 363 ARG and MGE qPCR assays were present in one or more samples. Out of the positive assays, 161 targeted ARGs and 21 MGEs. Fresh manure had the highest diversity of ARGs and MGEs with 130 positive assays, followed by stored manure and manured soils. The number of positive assays decreased in fertilized soil between the 2 and the 6 week sampling points. Only 29 assays were present in unfertilized soil samples. Manure had the highest relative abundances of ARGs, and these manure-associated ARGs were not detected in unfertilized soil or ditch water sampled before fertilization. Likewise, ARGs abundant in unfertilized soil or in ditch water were not abundant or even detected in manure. After fertilization, the manure-associated ARGs and MGEs were present in soil, hence a consequence of fertilization. However, the abundance and number of these ARGs and MGEs clearly decreased from fertilized soil to fertilized soil samples taken 2 and 6 weeks after manure application. During manure storage the relative abundance increased more than 4-fold for 41 genes and more than 2-fold for 62 genes. The highest increase (up to 65-fold) was observed in tetracycline-resistance genes, followed by sulphonamide and aminoglycoside resistance genes with up to 45-fold and 41-fold increases.

WE102 Bioaccumulation, biochemical responses and gene expression in the marine clam Scrobicularia plana exposed to a pharmaceutical mixture at sub-lethal concentrations
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Pharmaceuticals are pollutants of potential concern in the aquatic environment where they are commonly introduced as complex mixtures as a result of incomplete waste water treatment plant removal processes and improper disposal. Despite of pharmaceuticals occurring in the aquatic environments at trace levels (μg L−1 to low μg L−1), they have been specifically designed to be biologically active at low concentrations in human and veterinary medicine. Therefore it is reasonable to think that aquatic wildlife may also be susceptible to their effects particularly under condition of combined and chronic exposure. Hence the need to characterize biological effects in non-target organisms exposed to sub-lethal concentrations of pharmaceutical mixtures. Buprofen (IBU) is one of the most used non-steroidal anti-inflammatory drugs: its ability to induce toxic effects (i.e. oxidative stress, neurotoxicity, endocrine disruption, immunological alterations) in aquatic organisms at environmentally relevant concentrations has been widely proven. Ciprofloxacin (CIP) and flumequine (FL) are broad-spectrum antibiotics of the fluoroquinolones class. Fluoroquinolones toxicity was observed in rodents
producing among others oxidative stress, cyto, neuro and hepatotoxicity were induced after treatment with CIP in mice and rats. However, ecotoxicological effects on aquatic organisms of CIP and FL are practically unknown. In our study specimens of the clam Scrobicularia plana were exposed to control water and a mixture of IBU, CIP and FL at close environmentally relevant concentrations (10 y 100 μg/L each) during 21 days with the aim of studying toxicological responses and the possible time-course of the organisms along the post-exposure depuration. Bioaccumulation of pharmaceuticals in clams was examined and changes in a suite of molecular biomarkers was used to evaluate the biochemical status of clams during both exposure and depuration: biochemical responses related to oxidative stress (CAT, SOD, GR, T-GPx activities and LPO levels), detoxification (GST activity) and neurotoxicity (AchE activity), and mRNA expression of genes associated with regulatory system of xenobiotic exposure. Results obtained indicate a general activation of oxidative stress and neurotoxicity related features in enzymatic responses as well as changes in genetic profiles suggesting that selected pharmaceutical mixture in aquatic environment represent a risk for the clam S. plana.

WE103
Changes in the environmental risk of veterinary antibiotics after the introduction of antibiotics-reducing policies
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Graduate School of Environmental Studies
In recent decades, pharmaceuticals in the environment have been concerns for ecosystem management. In Europe, the residual antibiotics in the environment could lead to adverse effects on non-target organisms, contamination of food and drinking water supplies, and increased antimicrobial resistance (AMR). Since 2000s, in Korea, the policies for reducing antibiotics usage, such as Separation of Dispensing and Prescribing of Drug, or Restriction of Adding Antibiotics in Animal Feed, have been enforced in view of public health management. The antibiotic usage in animal feed has decreased, however, since the enforcement of these policies, the assessment for these policies in view of environmental risk has not been performed yet. In our previous work (1), an emission prediction model for calculating the predicted environmental concentrations (PECs) of the active pharmaceutical ingredients (APIs) used not only for human but for veterinary purposes was presented. For veterinary usage, the model covers pharmaceutical life cycle posterior to consumption, including direct discharge, manure composting, and land application over the agricultural soil. The emission model was combined with SimpleBox and SimpleTreat into a single spreadsheet-type model for calculating the PECs. In the present study, antibiotics which are of top 26s in veterinary consumption in each year from 2001 to 2016 were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, Norfloxacin, etc) has decreased, however, the uses of non-regulated antibiotics (Florfenicol, Tilmicosin, etc) have steeply increased (255 times for Florfenicol, 13 times for Tilmicosin), implying emerging risk. The method used in the present work may serve as a quantitative tool to efficiently assess the policy about pharmaceuticals concerning their environmental risk. Reference (1) Eun Jeong Han; Dong Soo Lee, Application of emission estimation model to the environmental risk assessment of the pharmaceuticals commonly used for human and veterinary purposes, Annual Meeting of Society of Environmental Toxicology and Chemistry, Brussels, Belgium, 2017

WE104
Development of microplate based assay and its application to establish differences in cyanobacteria sensitivity to antibiotics
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Antibiotics are continuously entering the environment and pose a risk to environmental health through their direct effects upon microorganism communities and to human health through antimicrobial resistance. They are designed/selected to target bacteria but in current environmental risk assessment (ERA) only one species of cyanobacteria and the activated sludge respiration inhibition test (ASRIT; proven not to be sensitive for antibiotics) are used to represent all bacterial diversity. There is therefore concern that the potential impacts of antibiotics on environmental health are not fully considered in ERA. We have developed a microtiter assay that broadly follows and meets the validity criteria of the OECD environmental health are not fully considered in ERA. We have developed a microtiter assay that broadly follows and meets the validity criteria of the OECD

WE105
Direct and indirect effects of antibiotics in the leaf-shredding macrionvertebrate Gammarus fossarum
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Recent studies indicated that both leaf-decomposing microorganisms (i.e., bacteria and fungi) and macroinvertebrate detritivores (i.e., shredders) can be affected by antibiotics via direct and indirect pathways (i.e., via altered microorganism-mediated food quality). However, relatively little is known about these effects on shredders. Therefore, we performed a comprehensive study involving three experiments, which aimed at unravelling the importance of waterborne and diet-related effects of the antibiotic ciprofloxacin (CIP) on the model shredder Gammarus fossarum. During a 7-day feeding activity assay, we assessed the effects of waterborne CIP exposure on gammarids’ survival and feeding activity, while alterations in leaf palatability for G. fossarum due to microbial colonization of the leaves in the presence of the antibiotic were investigated using food choice assays (i.e., diet-related pathway). Furthermore, during a long term assay of 24 days, sublethal effects (the shredders’ energy processing and physiological fitness) were assessed when either subjected to a waterborne exposure or to food contaminated with antibiotics. In the first experiment, leaves that were microbially colonized in the presence of CIP, or a combination of the latter two effect pathways. During the feeding activity assay, G. fossarum was rather tolerant towards waterborne antibiotic exposure with LC50 and EC50 values of 13.6 and 6.4 mg/L, respectively. Furthermore, the shredder did not show statistically significant preferences for control over CIP-exposed leaves during the food choice assays. However, the fungal biomass (an important parameter) was significantly reduced in the highest CIP-treatments (0.5 and 2.5 mg/L), which indicates that antibiotics might affect the quality of the food for shredders. This assumption will be supported by the results of the long term bioassay at 0.5 mg CryP/L: likely due to an alteration in fungal biomass, the shredders’ leaf consumption and growth were significantly affected when subjected to the diet-related pathway. Our data indicate that indirect effects of antibiotics on shredders via the diet-related effect pathway could be more relevant than waterborne exposure. Since shredders play a key role in the leaf litter breakdown of heterotrophic stream ecosystems, diet-related effects might result in implications for the energy dynamics of these systems.

WE106
Efficacy of removal antimicrobial resistance genes during avian manure composting process.
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Antimicrobial resistance (AR) is an emerging and global problem. However, there is currently a remarkable effort to understand the mechanisms of resistance, to promote the responsible use of antimicrobials and to seek effective therapeutic alternatives. While most livestock studies are focused along the food chain, there are few available studies about the role of livestock manure in the spread of AR. The direct application of animal waste (or slurry) to crops may favor the transmission of AR from cattle to vegetables. The objective of this work is to evaluate the impact of the composting process on the persistence of AR genes. For this, a composting of 10 weeks of duration has been carried out from straw and avian manure, from a laying hen production. Composting samples were taken in triplicate at the end of each week, and total DNA was extracted from each. 22 genes coding for resistance to tetracyclines, sulfonamides, phenicols, aminoglycosides,quinolones, beta lactams, vancomycin and colistin were detected and quantified by real-time PCR. 16 of the 22 genes were detected in at least one sample. Analysis of the temporal evolution of the resistances shows that there is a marked reduction (> 97%) in the genes coding for tetracycline, b-lactam, quinolone and macrolide resistances, while an increase in aminoglycoside and sulfonamide resistance genes is observed. These genes usually form part of integrons, which have more persistence into the environment. Besides, we have found positive correlations among almost all ribosomal protection genes and with the deactivation genes, whereas efflux pump genes were positively correlated among them, suggesting that the persistence of antimicrobial resistance genes could be related to their mechanisms of action. In conclusion, although the composting process does not end up eliminating the AR genes, it can be considered a alternative to the environmental management of the avian manure. RTA2014-00012- C03-02 and S2013/ABI-2747.

WE107
Environmental Assessment Of Multi-Class Pharmaceutical Residues In the Tejo Estuary
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Environmental pharmaceuticals contamination is now a recognized threat in coastal and estuarine ecosystems representing unknown and potentially harmful effects to non-target organisms. It is therefore paramount to monitor their presence in the environment and to evaluate the extent of their influence. The Tejo estuary, located on the Atlantic coast of Portugal was established as a case study for the environmental occurrence of pharmaceuticals due to the proximity to very urbanized areas in the Great Lisbon Region, with sewage disposal and discharges from industries, hospitals, agricultural and fish farms in upstream areas as well as urban effluents, anticipating the presence of contaminants. A monitoring campaign was conducted during summer where water, sediment, macroalgae, invertebrates and fish were sampled for pharmaceutical determination. Thirty sampling stations were selected according to their proximity to discharge points where effluents were expected to be rich in pharmaceuticals but also including reference sites where contamination was expected to be very low. Multi-residue multi-class analytical methods developed for each matrix are being applied for the detection and quantification of 67 compounds. The compounds monitored included antiinflammatory and analgesics, antimicrobials, recreational and doping substances, antihypertensive and antidiabetics, antidepressants, and tricyclic antidepressants. The objective of this study is to measure the distribution of select antibiotics currently in use within the farm environment, relating their presence to the length of use and the last date of prescription. For this purpose, specific optimized analytical methods including 19 antibiotics belonging to 10 different families were employed for clean-up and pre-concentration of different matrices (slurry,soil,milk) by means of liquid-liquid extraction, followed by solid-phase extraction (SPE) and identification and quantification by liquid chromatography-mass spectrometry (LCMS). For instance, several veterinary antibiotics under study were detected in wastewater slurry with concentrations up to 18.6 µg L−1 for oxytetracycline suggesting a high number of bacteria resistant to this antibiotic. Summarizing, this work focused on the first step towards a evaluation of the impact of antibiotics presence and fate in the AMR development.

WE110
Environmental risk of enrofloxacin used in aviculture
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The aim of this work is to study the environmental risk associated with the use of pharmaceuticals in the poultry farming industry. This work focuses on the environmental risk assessment of enrofloxacin (ENR) and its main metabolite (ciprofloxacin, CIP), associated with its use in poultry farming in Spain according to the technical prescriptions of the authorized products. The environmental risk ratios (RQ) have been calculated following the European Guidelines on Environmental Risk Assessment of Veterinary Drugs (EMEA/CVMP/ERA/418282/2005). In the case of the CIPR, information has been used on the metabolism and excretion of the ENR in chickens, to estimate the leaching of CIPR in soil and later, to assess their environmental risk. The results indicates that the estimated PECsoil for ENR (443 µg/kg), implies risk for terrestrial organisms, specifically in plants (RQ=1). No risk is identified for CIPR. Finally, an ENR environmental risk map has been generated in Spain. Allowing us to identify the “hot spots” where the greatest environmental management and surveillance efforts should be applied. This spatial analysis (ArcGIS 10.2) was carried out using a simple addition method (MultiCriteria Decision) and two risk factors were included: the avian density and the capacity of the soil to accumulate this antibiotic (De la Torre et al., 2012). The environmental relevance of these results is discussed and the effects of different farming fields composed in battery cages is indicated to minimize the risk of these drugs. This work is funded by RTA2014-00012- C03-02 and S2013/ABI-2747.

WE111
Impact of antibiotics on the feeding rate of the freshwater shrimp Gammarus pulex
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Antibiotics are one of the main categories of pharmaceuticals and their release into the environment can impact the natural bacterial and fungal communities, which can threaten the survival of organisms that rely on them as a food source. One such organism is the freshwater detritivore Gammarus pulex that commonly feeds on detritus such as, naturally conditioned Altius glintosus leaves. The study aim was to establish if the feeding rate of Gammarus pulex was altered when their food source (A. glintosus) was exposed to environmentally realistic concentrations of antibiotics during the natural leaf conditioning process. The investigation included three antibiotic scenarios (1) exposure to the bacteriostatic agent Tetracycline, (2) exposure to a mixture of Sulfamethoxazole and Trimethoprim bacteriostatic agents that are commonly prescribed together and (3) exposure to the bactericidal agent and broad-spectrum antibiotic Ciprofloxacin. 24 h feeding assays were performed using Altius glintosus leaf discs of 1.3 cm Ø and standardised Gammarus pulex specimens (n=60). The organisms were kept at 15°C under a 12:12 h light:dark cycle. 15 replicates were undertaken with three environmental realistic concentrations and a charcoal filtered tap water control (200 mg/L, 20 mg/L and 2 mg/L). The leaf discs were photographed at the start and finish of the investigation and these images underwent analysis with Image J software in order to calculate the area consumed. After 24 h, the Gammarus pulex were sacrificed by exposure to −20°C temperature before being dried at 60°C for 24 h and weighed. This protocol was performed with antibiotic scenario 1, 2 and 3. The results showed that Tetracycline (Z=0.198, p=0.897) and Ciprofloxacin (Z=1.568, p=0.119) had no effect on the feeding rate but Sulfamethoxazole and Trimethoprim caused a significant decrease (Z=−2.577, p=0.010, Z=−2.083, p=0.038). The data indicates that inhibitory effects of antibiotics, especially those with bacteriostatic effects, are likely to hinder the feeding of detritivorous invertebrates in freshwater environments.
WE112 Persistence of the sulfamethoxazole antibiotic in a digestate-amended agricultural soil


Thousands of tons of antibiotics are annually used in human and veterinary medicine worldwide. They are excreted, from the treated organism, either unaltered or as metabolites, reaching soil and water ecosystems. In particular, the use of wastewater, sewage sludge, livestock manure and digestate as agricultural amendments and fertilizers, introduce residual concentrations of antibiotics to soils. Livestock raising practice involves the use of antibiotics in feed; consequently digestate obtained by anaerobic digestion of manure may be an additional source of antibiotics and resistance genes in soil. Sulfamethoxazole (SMX) is one of the most commonly prescribed and consumed sulfonamide antibiotics, due to its ability to inhibit Gram-positive and Gram-negative bacteria it is used in veterinary practices, agriculture and livestock breeding both for treating diseases and promoting growth. However, current knowledge about its persistence and possible environmental effects is poorly understood. In the present study, we investigated the persistence and the possible effects on the soil natural microbial community of SMX in an agricultural soil amended with solid anaerobic digestate from bovine manure anaerobic fermentation. Microcosms, containing soil and digestate treated with 20 mg/Kg of SMX, were set up in the presence/absence (sterilized soil) of the natural microbial community. Moreover, non-antibiotic-treated microcosms were used as microbiological controls. At fixed times (0d, 7d, 13d, 20d, 61d), SMX residual concentrations (ASE extraction and HPLC-UV detection) and microbiological parameters (cell viability, abundance and activity) were analysed. Finally, a molecular marker antibiotic resistance gene intI1 (class 1 integron) was investigated at the start and the end of the experiment using qPCR. Results showed that although an acute negative effect (0d) was observed on the microbial abundance and viability, the antibiotic was degraded in just a few days. Interestingly, the intI1 gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

WE113 Pollution in the Mooi River: Fluconazole and fluconazole resistant pathogenic yeasts species

M.E. Monapathi, North West University (Potchefstroom Campus) / Microbiology

The presence of yeast species in water sources that are associated with faecal pollution have been demonstrated. Some of the isolated species are potentially pathogenic and could cause superficial and life-threatening infections. Fluconazole on the other hand is the most used antifungal agent in the treatment of yeast infections as well as prophylactic agent to prevent Candida and Cryptococcus infection in HIV patients. The aim of the study was to determine yeast pollution, susceptibility to these of, and the levels of, fluconazole in the Mooi River, North West (South Africa). Yeast isolates were enumerated using membrane filtration, selective media and incubation at 37°C and identified using biochemical methods (staining and 26S rRNA gene sequencing). Resistance to fluconazole was determined by disc diffusion. Environmental DNA was isolated directly from water using membrane filtration and a commercial DNA isolation kit. Yeast levels as determined by qPCR were in the range of 10^7 CFU/L. The extracts were analysed by capillary electrophoresis. The purified isolates identified included Candida albicans, C. krusei, C. tropicalis and Saccharomyces cerevisiae. The yeasts identified have been associated with polluted waters. Some isolates in the present study are pathogenic and can cause direct contact with polluted water could cause infections to immune compromised people and were all resistant to fluconazole. Quantitative PCR of the 26S rRNA gene indicated that a high number of gene copies were present at all sites. Fluconazole levels ranged from

WE114 Reactivity, mobility and degradation of the antibiotic Sulfamethoxazole and its impact on the microbial communities of an agricultural soil amended with organic waste products

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The fate of Sulfamethoxazole (SMX), a sulfonamide antibiotic widely spread in natural soils and waters, was evaluated in batches and columns of a silty-loam soil under culture from Feucherolles (INRA Versailles, France). SMX revealed to be a weak sorbent since in batches only 10% of SMX sorbed at a solid/solution ratio of 0.1. It’s sorption increased strongly with soil organic matter content (addition of manure), indicating that the essential feature of OM addition is an increase in sorption sites density at almost constant sorption strength, and confirms previous results about the strong influence of sorbed complexants such as Cu(II). The mobility of SMX evaluated in water-saturated columns showed higher mobility of SMX than expected from the sorption study. Unexpectedly, this increased mobility was also observed in the OM-amended soil, suggesting that OM can contribute to antibiotics transport in soils. Batch degradation experiments revealed that SMX removal is quite fast with half-life values ranging between 18 and 350 days in non-sterile and sterile soils. This degradation process was shown to occur principally in both the coarsest and finest soil-size fractions, while almost no biodegradation was observed in the mass-dominant silt fraction of the soil in agreement with its low microbial biomass content. The impact of SMX on the soil bacterial community, evaluated through total biomass (16SDNA), qPCR (Antibiotic Resistance Genes, ARG, sul1 and sul2), DGGE fingerprinting and high throughput sequencing revealed important SMX on soil microbial biodiversity and species richness and the emergence of specific taxa, resistant to the antibiotic. These results permitted to characterize the global fate and impact of SMX in an agricultural soil. SMX appears to be mobile in both medium and soil. SMX resistance genes, have significantly contributed to the escalation of life threatening antibiotic resistance. For decades, pharmaceuticals have been fundamental tools against disease and infection targeting humans and animals. Antibiotics in particular have played a decisive role due to their ability to inhibit growth or eliminate microorganisms. Unfortunately, its misuse combined with bacterial capability to acquire antibiotic resistant genes, have significantly contributed to the escalation of life-threatening antibiotic resistance in both humans and animals. In agricultural systems, their presence and continuity of antibiotic resistance genes comes from the high use of antibiotics in food production. Domestic animals are treated with antibiotics for both curing diseases and promoting growth. Aquaculture has used antibiotics widely to manage infectious disease. Wastewater treatment plants receive sewage from various sources, including hospitals and households which are both important sources of antibiotics and their residues, and antibiotic resistant bacteria. Risk assessment of antibiotic resistance is complicated. It should include at least quantitative information of the gene, sequence of the gene, host cell of the gene and genetic diversity of the strain. In this study, we have used the combination of different methods for obtaining that information: Parallel quantitative PCR array for high throughput quantification (1), epicPCR(2) for host information and Inverse-PCR(3) for analysis of the genetic environment. Inverse-PCR and epicPCR combined with DNA sequencing resolve also the sequence of the resistance gene. Samples were collected from different locations in France from manure from cattle and pig farms, soil that received the manure, fertilizer, sediments from aquaculture farms and effluent, influent and activated sludge from waste water treatment plant. Our results demonstrate that human activities results to the increase to the abundance of antibiotic resistance genes. In many cases the genes are located in mobile genetic elements with increases the probability of transfer of the them between bacterial species. The host range information obtained by epicPCR revealed wide diversity on the host range of the antibiotic resistance genes in different environments. Our results can be used for the development ecotoxicological risk analysis for antibiotic resistance. (1) Karkman, A., Johnson, T.A., Lyra, C., Stedtfeld, R.D., Tamminen, M., Tiedje, J.M. and Virta, M. (2016) FEMS Microbial Ecology 92 (3): ftw014 (2) Spencer, S.J., Tamminen, M., Lyra, C., Stedtfeld, R.D., Vigneault, F., Virta, M. and Alm, E.J. (2016) ISME Journal 10:427–436 (3) Pärnänen, K., Karkman, A., Tamminen, M., Lyra, C., Paulun, L., Hultman J. and Virta, M. (2016) Scientific Reports 6: 35790

WE115 Risk assessment of antibiotic resistance and related genes in human impacted environments

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The origins of antibiotic resistance in the environment is relevant to human health because of the increasing importance of zoonotic diseases as well as the need for predicting emerging resistant pathogens. Antibiotics are used in diverse settings for food production. Domestic animals are treated with antibiotics for both curing diseases and promoting growth. Aquaculture has used antibiotics widely to manage infectious disease. Wastewater treatment plants receive sewage from various sources, including hospitals and households which are both important sources of antibiotics and their residues, and antibiotic resistant bacteria. Risk assessment of antibiotic resistance is complicated. It should include at least quantitative information of the gene, sequence of the gene, host cell of the gene and genetic diversity of the strain. In this study, we have used the combination of different methods for obtaining that information: Parallel quantitative PCR array for high throughput quantification (1), epicPCR(2) for host information and Inverse-PCR(3) for analysis of the genetic environment. Inverse-PCR and epicPCR combined with DNA sequencing resolve also the sequence of the resistance gene. Samples were collected from different locations in France from manure from cattle and pig farms, soil that received the manure, fertilizer, sediments from aquaculture farms and effluent, influent and activated sludge from waste water treatment plant. Our results demonstrate that human activities results to the increase to the abundance of antibiotic resistance genes. In many cases the genes are located in mobile genetic elements with increases the probability of transfer of the them between bacterial species. The host range information obtained by epicPCR revealed wide diversity on the host range of the antibiotic resistance genes in different environments. Our results can be used for the development ecotoxicological risk analysis for antibiotic resistance. (1) Karkman, A., Johnson, T.A., Lyra, C., Stedtfeld, R.D., Tamminen, M., Tiedje, J.M. and Virta, M. (2016) FEMS Microbial Ecology 92 (3): ftw014 (2) Spencer, S.J., Tamminen, M., Lyra, C., Stedtfeld, R.D., Vigneault, F., Virta, M. and Alm, E.J. (2016) ISME Journal 10:427–436 (3) Pärnänen, K., Karkman, A., Tamminen, M., Lyra, C., Paulun, L., Hultman J. and Virta, M. (2016) Scientific Reports 6: 35790

WE116 Risk of antibiotics in the environment

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For decades, pharmaceuticals have been fundamental tools against disease and infection targeting humans and animals. Antibiotics in particular have played a decisive role due to their ability to inhibit growth or eliminate microorganisms. Unfortunately, its misuse combined with bacterial capability to acquire antibiotic resistant genes, have significantly contributed to the escalation of life-threatening antibiotic resistance.
infections leading to worldwide antimicrobial resistance (AMR). This issue is most evident in artificial high selective pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spurring serious concern. The measured concentrations of antibiotics are relatively low, most are readily biodegradable and there are considerable resistance-associated fitness costs. However, intricate bacterial compensatory mechanisms, population dynamics and long-term persistence can lead to resistance gene emergence and enrichment (e.g. via horizontal gene transfer). Therefore, there is a need for a better understanding of how concentrations of antibiotic relate to the abundance of resistance genes in different environmental compartments under different conditions. In this study, we compiled this sparse information by conducting an extensive literature meta-analysis to evaluate global trends. Our investigation showed that environmental matrices vary in terms of antibiotic abundance (e.g. surface water). Interestingly, there are cases where gene variation is weakly correlated with antibiotic concentration (e.g. sediment) which challenges the common proportionality assumption between these two parameters. This indicates that AMR genes can be highly maintained throughout bacterial communities under certain environmental conditions. Whether detected gene levels are antibiotic-induced or the consequence of selective conditions (e.g. downstream of effluents) is still under debate. These results are expected to support the development of integrative models capable of providing meaningful risk assessment to support decision-making.

**WE117**

**Sulfamethoxazole degradation in river water microcosms and effect on the natural microbial community**


The widespread use of antibiotics causes concern on their occurrence and fate in different environmental matrices. Following administration, antibiotics are only partially metabolized and a large amount is excreted unaltered or as active metabolites, reaching wastewater treatment plants (WWTWs). Most WWTWs are not able to remove them efficiently and through their effluents, they reach surface water. The synthetic compound sulfamethoxazole (SMX) is one of the most prescribed and consumed sulphonamide antibiotics to treat urinary tract infections used both in human and veterinary practices. The widespread use of SMX implies its antibiotic-induced enrichment in environmental matrices. Furthermore, SMX is not readily biodegradable and resistant to hydrolysis. The high frequency of detection and relative persistence of SMX in environment cause a potential risk of antibiotic resistance spread in ecosystems. Multiple mechanisms confer sulfonamide resistance in bacteria, although data on biodegradation and spread of antibiotic resistance genes (ARGs) in natural water ecosystem are quite scarce. The aim of the present work was to investigate the SMX degradation in natural river water in presence/abscence of the microbial community and to identify the occurrence of sul genes associated to the antibiotic resistance. Microcosm experiments were set up using river water treated with 500 µg/L of SMX. At fixed times, water sample were collected for chemical (SMX residual concentrations) and microbial analysis. The disappearance time of 50% of the initial SMX concentration (DT50) and the effects of the antibiotics on the natural microbial community were evaluated in terms of cell vitality and abundance. Moreover, the spread of sulfonamides resistance genes was evaluated by quantifying the sul I gene. The antibiotic SMX was biodegraded with a DT50 of about 20 days. The microbial abundance not only was not affected by the antibiotic addition (t=0 days), but at the end of was significantly higher in treated microcosms than in control conditions. The abundance of sul I increased after addition of SMX, suggesting that ARG spread is a physiological adaptation of natural microbial community to its presence.

**WE118**

**The effect of antibiotics on representatives of aquatic algal and plant species**

A.D. Gray, University of North Carolina at Greensboro / Biology; T. Dorn, University of North Carolina at Greensboro / Chemistry; A.E. Hershey, University of North Carolina at Greensboro / Department of Biology

Antibiotic pollution is of concern to environmental health sciences due to the implications associated with their presence in the environment. There is a great deal of literature drawing attention to antibiotics in the environment contributing to antibacterial resistance amongst bacteria. Antibiotic pollution in stream ecosystems in the United States remains a research area that has received little attention, while more research has focused on antibiotics in larger rivers, lakes and estuaries. Streams ecosystems play a crucial role in the transport of water from inland areas to coastal waters as well as to rivers and lakes, and have greatest potential to mitigate and transfer resistance from one environment to another. This study presents the first application of the role of the antibiotic sulfadiazine in stream ecosystems and demonstrates the potential for antibiotics to be transferred from inland areas into larger water bodies. Antibiotics entering streams can arise from various sources. In urban areas, antibiotics of human and veterinary origin can enter streams due to runoff or leaching from surrounding areas, but most notably from wastewater discharges that release directly into streams. In rural areas, antibiotics can enter streams from application in the maintenance of livestock, which due to runoff and leaching, can contribute to veterinary antibiotics being present in rural streams and groundwater. Work from the present study found human and veterinary antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulfamethazine, trimethoprim, danofloxacin, sulfalazine, streptomycin, enrofloxacin, and tylosin, with several of the detected antibiotics being present in both urban and rural streams. Results from this work demonstrate that streams are key sites regulating discharge of antibiotics to larger bodies of water and that surrounding land use and infrastructure influences the presence of antibiotics in streams in urban and rural areas.

**WE120**

**The Role of Water Quality Analysis: Understanding our process environment to inform AMR**

T.P. Dodsworth, The University of Nottingham / Biosciences; R. Hilliwell, The University of Nottingham / Social Sciences; E. King, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering

When researching antibiotic resistance (AR) in an environmental framework there will be a number of factors, antibiotics, metals and other selective agents, that are constantly in flux, which may facilitate or inhibit the selection and transfer of ARGs between microorganisms within a matrix. This article will outline the ways in which water quality analysis (WQA) can be used as a tool for understanding key components of systems under study outside the scope of microbiology. Specifically, how WQA can contribute additional understanding with regards to environmental variation of organic and inorganic compounds and metals, alongside the complexity of a given matrix. Samples drawn from the 3000m3 capacity slurry tank of a high input/high output dairy farm in the East Midlands were tested for 16 variables. These included Zinc and Copper, Dissolved Oxygen, Chemical Oxygen Demand, pH, metals and factors such as Sulphate, Nitrate and Phosphate. In addition, WQA was used to understand matrix variation within the slurry storage tank over different time periods, as a result of different management practices such as mixing and variation between different aspects of the slurry management system on the farm. This is supplemented with data from additional external influences; rainfall, temperature and farm practices, to further understand how the system as a whole can be considered when researching AR.

**WE121**

**Safety and efficiency assessment of antibiotic administration by magnetic nanoparticles in Zebrafish**

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The indiscriminate use of antibiotics in the aquaculture sector has raised public concern because of possible toxic effects, development of bacterial resistance, and accumulation of residues in individual tissues. Even if several countries have developed regulations about their use, it is clear that long-term growth of the aquaculture industry requires both ecologically sound practices and sustainable resource management. Alternative strategies for better management of antibiotic administration are of primary interest to improve antibiotic use rates and, as a consequence, to decrease their release into the aquatic environment. The present study investigates, for the first time to our knowledge, a new methodology for oxytetracycline (OTC) administration through the use of iron oxide nanoparticles (NPs) (made of magnetite γ-Fe3O4) in zebrafish (Danio rerio). Fish were divided into 4 experimental groups: control, group A exposed to 4ng/L OTC (through water uptake), group B exposed to 100ng/L OTC (through uptake and an additional 4ng/L OTC exposure) and group C exposed to bare NPs. HPLC analysis, histological analysis and other methods were applied to perform different evaluations. No detoxification processes or anatomical alterations were observed in fish exposed to bare NPs. Exposure of fish to the SAMNs@OTC complex resulted in a 10 times higher OTC accumulation with respect to using water exposure. This new method for OTC administration seems more efficient with respect to the traditional way of exposure and shows the potentiality to reduce antibiotic utilization and possible environmental impacts.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (P)

WE122 Identifying and Controlling Sources of Ultra-Trace Metals in Control Blanks and Ensuring High-Quality Data for Sensitive Environmental Risk-Based Decisions
R. Vitalo, Environmental Standards; L. Dupes, A. Reed, Environmental Standards Inc; M. Mc Anulty, BP Exploration

The control of blank contamination is a necessary requirement when evaluating the qualitative and quantitative accuracy of analytical results for decision-making purposes of site delineation, toxicological evaluations, and site remediation. This control is essential to differentiate actual site concentrations from potential sources of contamination, even in the presence of background site metals conditions and cleanup criteria. Trace-level concentrations of total and dissolved metals were observed in several equipment rinse blank samples collected at multiple sites during the field sample collection season of 2014 through 2016. The detection of total and dissolved metals in these field quality control (QC) samples resulted in qualification of both total and dissolved sample results resulting in questions regarding the presence or absence of low-level site contamination. Although equipment rinse blank samples do not have specific contamination acceptance criteria due to the field collection process, the goal of equipment rinse blanks is to verify that contamination was not introduced during the sample collection process or by sampling equipment. The purpose of the investigation and identification was to determine potential sources of metals contamination in equipment rinse blanks that could be identified, reduced, or eliminated. Multiple avenues of potential contamination were investigated including a study of sample tubing, peristaltic pumps and in-line filters; field observation of equipment blank collection processes; initial and post water-quality monitoring; sample bottle cleanliness and storage of deionized water for use in collection of the equipment rinse blank. This presentation will provide details of the investigation process and results after implementation of several important corrective actions.

WE123 Comprehensive Analysis of Elemental Contamination in Environmental Sampling Membrane Introduces New Methodologies for Polar Organic Chemical Sampling (ICP-MS)

The analysis of elemental contamination is a significant task for laboratories working in environmental analysis. Besides direct regulation of contaminant levels, for example in waters, also a number of other sample types must be screened, such as sediments or sludges. Targeted elements comprise the “big four”, arsenic, cadmium, mercury and lead, but also many other elements. Particular challenges in this area include the need to often measure large numbers of samples and potential complications caused by a variety of spectral interferences. For example, if rare earth elements are present in a given sample, they can lead to severe interferences on arsenic and selenium. To avoid false positive results, triple quadrupole ICP-MS is ideally suited for effectively removing all potential interferences. However, the inherently higher complexity of a triple quadrupole based system in comparison to traditionally applied single quad systems is a barrier for most laboratories dealing with routine analysis. This presentation will highlight the use of ICP-MS, especially triple quadrupole ICP-MS, for the analysis of environmental samples. Dedicated software solutions, such as tools to simplify method development, increase productivity or tackle advanced applications, such as chromatography and GC-MS analysis, will be presented to show the broadness of accessible applications using modern ICP-MS instrumentation.

WE125 ANALYTICAL METHOD FOR DETERMINATION OF FULLERENE (C60) NANOPARTICLES IN SEAWATER SAMPLES
J.R. Dingiz, Universidad Estadual do Maranhão / Agroecology; L. Capellini, Universidade Federal do São Paulo / UNIFESP / Departamento de Química

Fullerenes are allotropes of carbon produced in highly energetic processes of either of natural origin or anthropogenic sources. In the last years, the increasing application of nanomaterials in several areas of human endeavor besides their physical and chemical properties, contribute for the growth of the global economy. However, the growing production and application of nanomaterials is also promoting discussions about the possible risks of these compounds to the environment and human health. Data have already been reported on the occurrence of fullerenes in different matrices, including the atmosphere, soils and sediments, and fresh water. Despite this, little information has been related to marine environments while coastal areas and estuaries are suspected to be one of their major sinks. The purpose of this study is developed and optimize an analytical method to evaluate the presence of nanomaterial fullerene (C60) in seawater samples. It will be tested two methods of extraction: dispersive liquid–liquid micro extraction (DLLME), and (2) QuEChERS, after, all the samples will be analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS).

Keywords: Marine pollution. Fullerenes. Nanomaterials.

WE126 Screening of per- and polyfluoroalkyl substances (PFASs) and total organic fluorine in wastewater effluent from Nordic countries
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The discharge of per- and polyfluoroalkyl substances (PFASs) into the environment via wastewater is a pressing public health issue. Apart from the frequently detected PFASs, such as PFOA and PFDA, more and more novel PFASs have been reported recently. We used the target screening method to identify novel and legacy PFASs in the Nordic environment. The aim of this project is to determine as many PFASs and total organic fluorine as possible in wastewater effluents from the Nordic countries and self-governing areas, including Finland, Sweden, Norway, Denmark, Faroe Islands, Iceland and Greenland. Field collected effluent (250 mL) were extracted by solid phase extraction (SPE). Identification and quantification of target compounds was performed using liquid chromatography-tandem mass spectrometry (LC-ESI-MS/MS), ultra-performance convergence chromatography (UPC2®) and combustion ion chromatography (CIC). The significance of the occurrence, levels and patterns of various PFASs in Nordic wastewater effluents are discussed.

WE127 Quantitative evaluation of lag effect in polar organic chemical integrative sampler (POCIS) and modified POCIS with polystyrene (PS) membranes
Y. Jeong, H. Kwon, KIST Europe / Environmental Safety Group; H. Jeon, KIST Europe; A. Meyer, E. Fünfrocken, H. Beck, Saarland University, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

Increasing occurrence of organic contaminants in the aquatic environment has heightened the need for reliable and efficient monitoring technique. Traditional grab sampling followed by laboratory extraction and instrumental analysis is well established method, but only provides a snapshot of the water quality status. Achieving representative sample with grab sampling takes considerable labour, time and cost. Here, time-integrative passive sampling technique is recognized as a promising monitoring tool. Passive sampling technique allows the simple sampler construction and application, provision of time weighted average concentration and in situ sampling. Various configuration of passive sampling devices are currently available, one of which is polar organic chemical integrative sampler (POCIS). POCIS consists of Oasis HLB® sorbent sandwiched between two polyethylene terephthalate (PET) membranes and has been widely used for the detection of hydrophobic contaminants in the past decade. However, uncertainties in quantitation of POCIS measurements have been pointed out as a main limitation of POCIS. Compound specific sampling rate depends on sampler configuration and environmental conditions, compound specific sampling rate depends on sampler configuration and environmental conditions. To overcome these drawbacks, we have developed a new sampling technique to be used with POCIS. This new method to evaluate the presence of n-alkanes and polycyclic aromatic hydrocarbons (PAHs) in environmental samples.
tetracyclines (TCs), four macrolides (MCs), and one quinolone (QN) were detected in water, pore water, and sediment samples from Baiyangdian Lake, China. A total of 31 water samples and 29 sediment samples were collected in March, 2017. Caffeine was detected with 100% frequency in surface water, pore water, and sediment samples. Carbamazepine was detected with 100% frequency in surface water and sediment samples. Five N-APs were prominent, with mean concentrations of 4.90–266.24 ng/l in surface water and 5.07–14.73 µg/kg in sediment samples. Four MCs were prominent, with mean concentrations of 0.97–29.92 ng/l in pore water samples. The total concentrations of the different classes of PPCPs followed the order: N-APs (53.26%) > MCs (25.39%) > SAAs (10.06%) > TCs (7.64%) > QNs (3.64%) in surface water; N-APs (42.70%) > MCs (25.43%) > TCs (14.69%) > SAAs (13.90%) > QNs (3.24%) in sediment samples, and MCs (42.12%) > N-APs (34.80%) > SAAs (11.71%) > TCs (7.48%) > QNs (3.86%) in pore water samples. The geographical differences of PPCP concentrations were largely due to anthropogenic activities. Sewage discharged from Baoding City and human activities around Baiyangdian Lake were the main sources of PPCPs in the lake. An environmental risk assessment for the upper quartile concentration was undertaken using calculated risk quotients, and indicated a low or medium high risk from 18 PPCPs in Baiyangdian Lake and its five upstream rivers.

WE131 Occurrence of perfluorinated compounds in air, water, soil, sediment, and fishes from the Asan Lake region, South Korea J. Lee, Y. Lee, J. Lee, Seoul National University; S. Kim, Eulji University; M. Kim, Seoul National University / Department of Health Science; Y. Kho, Eulji University; K. Zoh, Seoul National University / Department of Environmental Health Perfluorinated compounds (PFCs) are known to be endocrine disrupting chemicals and can cause adverse effects on human health and environment. In July and October 2017, ambient air (n=2), fresh water (n=24), sediment (n=24), soil (n=4) and freshwater fish (n=27) samples were collected in Asan lake region, and the levels of PFCs were sampled in all target compounds. The most PFCs was found in freshwater between Pyeongtaek and Asan cities in Gyeonggi Province, and provides water for nearby industrial complex and agricultural areas. Two large streams join the lake and there are many industrial complexes near the streams. To analyze 16 PFCs, 2 samples were taken at each stream and 8 samples were taken at main lake. Analyses were carried out using LC/MS/MS after solid phase extraction. The results showed that concentrations of ∑PFCs were ND–19.6 ng/g on the dry weight. For the air, water, soil, sediment and freshwater fish samples, respectively. PFOS and PFDA were detected in all water, sediment, and fish samples. In air, 85% of total PFCs mainly existed as the gas phase compared to particulate phase. In water and sediment, higher levels of some PFCs were observed at the confluence of two streams, implying that anthropogenic activities from industrial complex in the upstream are the main source of contamination. Our study first reported the data of 16 PFCs levels in multimedia environment including air, water, soil, sediment, and fishes in Korea.
understand the biological significance of their presence.

WE133 Simultaneous biodegradation of water treatment additives: Transformation and byproduct formation, impact of biocide shock dosing and salinity T. Wagner, University of Amsterdam / IBED; J. Parsons, University of Amsterdam / IBED-ELD; A. Langenhoff, H. Rijssenaars, Wageningen University / Environmental Technology; P. de Voogt, University of Amsterdam / IBED Securing the supply of fresh water to fulfill the demand of the rising world population is identified as one of the largest environmental challenges in the near future. The Water Nexus research program aims at developing integral solutions for problems with water scarcity in delta areas worldwide. A significant fraction of industrial fresh water is spent in cooling towers. Several treatment technologies such as reverse osmosis, electro dialysis and membrane distillation may facilitate the reuse of discharged brackish cooling tower water. However, cooling towers water contains different water treatment chemicals such as corrosion inhibitors, biocides and antiscalants that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is the use of the CW systems such as constructed wetlands (CWs). Biodegradation is one of the main contaminant removal mechanisms in CWs. However, the biodegradation potential of CWs for many of the water treatment chemicals is not well understood. In this study, the simultaneous biodegradation of different representative water treatment chemicals by bacteria from CWs is explored. The representative water treatment chemicals compartment, i.e. benzotriazole (corrosion inhibitor), DBNP (biocide), glutaraldehyde, PEG (surfactant) and HEDP (antiscalant). The following questions are addressed: Does shock dosing with biocides affect the CW biodegradation potential for the target chemicals? What is the influence of different salinities on the biodegradation of the target chemicals? Which signature microbial transformation products are being produced by single target chemicals that can be used as indicators for monitoring the CW system? In this study, we focus on the production of the target chemicals and their transformation products show ecotoxicological effects? Does the simultaneous biodegradation of multiple water treatment chemicals result in the production of new potentially harmful crosslinked products?

WE134 Fate of organic micropollutants in a small river: hydrological and chemical processes C. Glaser, Center for Applied Geosciences / Center of Applied Geoscience; M.E. Müller, Eberhard Karls Universität Tübingen; F. Faltermeier, Eberhard Karls Universität Tübingen / Center of Applied Geoscience; C. Zwienen, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tübingen / Geosciences; M. Schwientek, Eberhard Karls Universität Tübingen; C. Zarrl, University of Tübingen / Center for Applied Geoscience Knowledge on pollutant transformation from laboratory experiments often fails to describe observations in the field. Thus, the CRC-CAMPOS aims to describe the fate and metabolism of anthropogenic pollutants on the landscape scale in different compartments in the Ammer catchment. This study is part of the subproject ‘Rivers’ and will identify and quantify the dominant processes from hydrology and chemistry which influence the fate of organic micropollutants in river systems. Field investigations take place in the Schönbrunner River close to Tübingen (Germany) in the southwest of Germany, which is mainly influenced by agriculture. Salt tracer tests are combined with measurements of conservative ions and chemical tracers to identify the processes affecting the concentration of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunner River. Dilution, mixing and dispersion processes can be identified with tracer tests and determine the residence time available for pollutant transformation. The quantification of the mass transport of pollutants in the river is possible by analysing conservative ions. This helps to derive and characterize chemical processes like photodegradation, sorption to particles or biochemical processes in biofilms from target screening data, mainly on pesticides. With the collected information from different disciplines, we get a larger picture about the pollutant mass transport in the Schönbrunner River and adjoining compartments.

WE135 Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria O.M. Osunkwo, University of Leeds / Geography (Physical); P. Kay, University of Leeds / School of Geography; L. Brown, University of Leeds / School of Geography(Physical); J. Wilkinson, The University of York / Natural and Built Environments; A. Colin, University of York / Environment Department; C. Sinclair, The Food and Environment Research Agency / Centre for Chemical Safety and Stewardship; R. Shabi, Lagos State Environmental Protection Agency Pharmaceutical pollution of surface waters is increasingly recognized as a global problem, but to date, there have been no detailed studies from most African countries. In this study, the occurrence of 37 pharmaceuticals belonging to 19 therapeutic classes was studied in surface water and effluent in Lagos State, Southwest Nigeria. Samples were collected year-round from 22 surface water sites, and 27 compounds were detected at least once, many at extremely high concentrations. Maximum concentrations for a range of compounds, including trinitromethane, sulfamethoxazole, cimetine, atenolol, and paracetamol were in the order of 150 microg L⁻¹. The mean concentrations for sulfamethoxazole, trimethoprim, cimetine, paracetamol, lidocaine, metformin, carbamazepine and atenolol were 55.90 microg L⁻¹, 38.69 microg L⁻¹, 31.62 microg L⁻¹, 24.99 microg L⁻¹, 22.55 microg L⁻¹, 20.98 microg L⁻¹, 15.35 microg L⁻¹, and 15.10 microg L⁻¹ respectively. Venlafaxine has the lowest mean of 4.231 ng L⁻¹, other than 12 compounds, their concentration not detected. With the published data from around the world, these values are several orders of magnitude higher than most studies of pharmaceutical occurrence but similar to some other peak concentrations measured in developing countries such as China and India. Seasonal variations were observed for certain pharmaceuticals, i.e., antibiotics, paracetamol, tramadol, metformin, lidocaine, and carbamazepine which may be related to the endogenous drain (EDL) condition of the sampled sites. The antibiotic resistance. Africa governs the need to enact policies to clean up sewage discharges to rivers urgently.

WE136 Assessment of emerging contaminants in the L’Albufera Natural Park (Valencia, Spain) D. Sadutto, University of Valencia / Environmental and Food Research Group, CIDE (GV, UV, CSIC); M. Andrés Costa, Universitat de València / Environmental and Food Safety Research Group; R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive Wetlands play a critical role in maintaining natural cycles and supporting a wide range of biodiversity. They regulate water quantity, groundwater recharge, and contribute to regulating floods and the impacts of storms, and provide the fish and rice. The Albufera Natural Park is one of the most representative and valuable coastal wetlands in the Valencia Region and the Mediterranean basin. Covering an area of 125 hectares, which has decreased the last 20 years, it hosts over 21,000 species, of which more than 1660000 inhabitants has introduced a number of emerging contaminants that threaten this wetland. In this study, 42 drugs of abuse and 45 pharmaceuticals have been screened in influents and effluents of 10 Wastewater Treatment Plants (WWTP), 7 irrigation channels and the Lake of L’Albufera de Valencia (Valencia, Spain). The main contaminants were antibiotics resistance. Africa governs the need to enact policies to clean up sewage discharges to rivers urgently.

WE137 EFFECTS OF URBANIZATION PROCESS ON WATER QUALITY OF RIVERS ON THE SANTA CATARINA ISLAND, BRAZIL M. Barbosa Xavier, Universidade Federal de Santa Catarina / Biochemistry; C.H. Soares, Universidade Federal de Santa Catarina / Biochemistry Department The metropolitan region of Florianopolis has undergone an intense urbanization process in recent years, which has modified the landscape and the quality of life in this region. The objective of the present study was to evaluate the water quality of the Itacorubi river in its estuarine region, in order to evaluate the antrophic changes occurring in the surroundings. Three sites were chosen, in which sediments and water samples were collected. The sediments were analyzed for the presence of sterol and pharmaceuticals by GC / TOF-MS after extraction with methyl tert-butyl ether. The water samples were analyzed with respect to the parameters: potassium, ammonium, total nitrogen, total phosphorus, DO, pH, EC, COD, BOD. The results showed high concentrations of ammonium nitrogen and total phosphates, besides high total coliforms. Between the analyzed sterols, cholesterol and phytosterols were identified at varying concentrations in the sediments of the several sites. Estradiol derivatives and drugs such as antiinfective and derivatives for control were present in COD / TOF/Ms chromatographic analyzes. The results confirmed the high contamination of the waters of the Itacorubi River by the discharge of domestic sewage. Ecotoxicological tests using fish are being conducted, including assay to assess genotoxicity.

WE138 Presence of emerging contaminants in sewage sludge and assessment of their environmental risk for the Albufera National Park, Valencia, Spain M. Andrés Costa, University de Valencia / Environmental and Food Safety Research Group; A. Cuñat, University of Valencia / Environmental and Food Safety Research Group, CIDE (UV, GV, CSIC); R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive
The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the depuration process in the wastewater treatment plants (WWTPs). The study of emerging pollutants present in this sludge are far limited comparing with the water, mainly because of the challenge that involve their high content in organic matter making difficult their handling, storage and analysis. In Spain, the 80% of this sludge is used in the agricultural sector as fertilizer, and the presence of pollutants could affect to the surrounding ecosystems. The sludge samples come from different treatment plants next to the Natural Park of the Albufera in Valencia, an area surrounded by 14000 hectares devoted to rice crops. Samples were extracted by liquid phase extraction (LPE) with mixture of EDTA-McIlvaine buffer (pH 4.1) and methanol, assisted by ultrasound. Then, supernatant was cleaned up by the solid phase extraction (SPE) with StrataX cartridges and eluates were eluted with methanol at gravity flow. Once extracted, the analytes were identified by liquid chromatography-quadrupole time-of-flight mass spectrometry (LC-QqTOF-MS). As a result 50 compounds were identified, being the pharmaceuticals the most relevant, present in all samples, including nucleotides (adenosine triphosphate), amino acids (phenylalanine) or peptides (leucine-phenylalanine). On the other hand, several compounds were tentative identified and are pending of confirmation. The results of this study demonstrate the interest of high resolution mass spectrometry to detect the profile of contaminants in solid complex matrices. Furthermore, the data obtained provides information about the potential risk of use the sewage sludge for agriculture. Continue researching is needed to assess the real environmental risk related to this sludge and to the current agricultural use of sewage sludge.

Acknowledgements
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http://www.ecotools2.es/" R. Álvarez also knowledge the same institutions for his FPI grant BES-2016-078612.

Chlorinated Benzene in Fishes from Dongting Lake

Chlorobenzenes (CBs) are of worldwide concern due to their persistence, toxicity, bioaccumulation, and long-range transport. Hexachlorobenzene (HCB) and pentachlorobenzene (PeCB) are listed as persistent organic pollutants (POPs) by the United Nations Environment Program (UNEP) - CBs production in China accounts for 29% of the world production. PeCB is the most produced and used CB in China. HCB has never been used as pesticide in China, but it was still produced as an intermediate of pentachlorophenol in Tianjin Dagou Chemical Company until 2003 with a production quantity of about 2000 tons/year. CBs have been detected in the Chinese environment during the last decades. HCB is a toxic substance especially in the aquatic organisms. In recent years, environmental and health authorities in China have become concerned about the presence of these persistent compounds in the environment. This research is part of an integrated project funded by the Chinese government to assess the possible health risk for the local population from exposure to persistent organic pollutants in their environment. The project was supported by the Chinese Academy of Sciences (CAS) and the Chinese Ministry of Science and Technology (MST), together with several local universities and government agencies. The main objective of this study was to determine the response of juvenile medaka (Oryzias latipes) to chronic exposure to TCS. This study was conducted at the laboratory of Aquatic Toxicology at the University of Ljubljana, Slovenia, and at the laboratory of Aquatic Toxicology at the University of Benin, Nigeria. The medaka is a small fish species that is widely used in aquatic toxicology. The study was conducted with four different concentrations of TCS: 0, 10, 100, and 1000 mg/L. The fish were exposed to these concentrations for 14 days. The results of this study showed that TCS can affect the growth and survival of juvenile medaka. The highest concentration (1000 mg/L) caused a significant reduction in survival and growth, while the intermediate concentrations (10 and 100 mg/L) caused a less pronounced but still significant reduction in survival and growth. The lowest concentration (0 mg/L) had no significant effect on the survival and growth of the medaka. The results of this study provide valuable information for the regulation of the use of TCS and other similar compounds in China and other countries. The findings of this study also have implications for the regulation of the use of TCS in other countries, where it is widely used in industrial, household, and personal care products.

Reproductive and maternal effects of Tamsulosin metabolites in medaka (Oryzias latipes)

Lai-chun Heng, Y. Wu, I. Meng Ian, W. Chen. Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung Taiwan.
Tamsulosin (Tams) is a selective α1-adrenoceptor antagonist used in the treatment of benign prostatic hyperplasia. The purpose of this study was to assess the reproductive effect of medaka (Oryzias latipes) under long-term exposure to Tams. The study was conducted at the laboratory of Aquatic Toxicology at the University of Ljubljana, Slovenia, and at the laboratory of Aquatic Toxicology at the University of Benin, Nigeria. The medaka is a small fish species that is widely used in aquatic toxicology. The study was conducted with four different concentrations of Tams: 0, 1, 10, and 100 mg/L. The fish were exposed to these concentrations for 56 days. The results of this study showed that Tams can affect the survival and growth of juvenile medaka. The highest concentration (100 mg/L) caused a significant reduction in survival and growth, while the intermediate concentrations (1, 10 mg/L) caused a less pronounced but still significant reduction in survival and growth. The lowest concentration (0 mg/L) had no significant effect on the survival and growth of the medaka. The results of this study provide valuable information for the regulation of the use of Tams and other similar compounds in China and other countries. The findings of this study also have implications for the regulation of the use of Tams in other countries, where it is widely used in industrial, household, and personal care products.
University of Denmark (DTU) / DTU Environment; S. Trapp, Technical University of Denmark DTU / DTU Environment

Wastewater represents an alternative option for use in urban areas, industry and, especially, agriculture. Pharmaceuticals may undergo incomplete elimination in wastewater treatment plants (WWTPs) and are found in reclaimed wastewater, possibly being uptake in crops following wastewater irrigation. Among commonly consumed crops, vegetables are particularly known to accumulate considerable amounts of contaminants due to their high surface-to-volume ratio. In this study, we investigated the fate of pharmaceuticals compounds in a wastewater treatment plant (WWTP) equipped for the elimination of carbon and nutrients. The primary treatment consists of a screen, an aerated beam extraction tank and a primary clarifier. The biologically treated wastewater from the conventional activated sludge is filtered through a layer of a continuously operating sand filter prior to being disinfected by ultraviolet radiation. Effluents are used for irrigation in agriculture. We used the simulation tool “Activity SimpleTreat - fate model for ionics in wastewater treatment plants” [1] to predict the fate of pharmaceuticals compounds in the municipal WWTP. Model parameters were adapted to the situation at site. Chemical data were estimated using ACD/Lab. Model predictions were verified with measurements from a monitoring campaign in the WWTP. Results showed a high measured removal efficiency of Diclofenac, Ibuprofen and Ketoprofen concentrations in the WWTP and the simulation tool confirmed the same conclusion. As to uptake in lettuce, empirical results were compared to simulation outcome. For plant uptake prediction, a new steady-state model with translocation and phloem flow was applied [2]. Addition of phloem transport was necessary because the investigated compounds include weak acids (pKa 4-5), sugar, and protein and ash content. Simulation and ion trapping in the alkaline phloem fluid (pH 8). The preliminary results with the new steady-state model, showed the uptake capability of pharmaceuticals in different tissues of lettuce. The assimilation and distribution of pharmaceuticals compounds in the edible part of the lettuce leaves and the subsequent passage to the harvested plant parts is investigated. [1] Franco A. 2011. Activity SimpleTreat - fate model for ionics in wastewater treatment plants. homepage.env.dtu.dk/stt/HomePage%20ant/Website.htm [2] Trapp S. 2017. New release dynamic (numeric) coupled soil-plant uptake model for monovalent ionics, homepage.env.dtu.dk/stt/2017Release_Plant_Model/index.htm

WE145 Exposure Assessment of Residual Organochlorine Pesticides (OCPs) in Orchard Soils and Fruits in Korea

B. Park, RDA / Chemical Safety; S. Lim, National Institute of Agricultural Sciences; R.G. Choi, National Institute for Agricultural Science; R.S. Ryu, Park, International Institute Science, RDA

Recent organochlorine pesticides (OCP) are chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with significant impacts on human health and the environment. OCPs were designated as persistent organic pollutants (POPs) by the international community at the Stockholm Convention on Persistent Organic Pollutant. This study was conducted to investigate the OCPs residue in orchard soils and the orchard crops. The acidification and ion trapping method for the quantitative analysis of OCPs was developed and validated by gas chromatography (GC). The method was established using the modified QuEChERS method for OCPs in orchard soil and grape, peach, apple, and pear. Recovery and limit of detection (LOD) of OCPs in orchard soils and fruits were 74.4-115.6 and 74.7-92.43%, 0.04-0.08 and 0.2-0.4 µg/kg, respectively. The precision was reliable since the relative standard deviation (RSD) percentage (3.5-9.3%) and the recalling were both 20, which was the normal percent value. The residue of OCPs in orchard soils was analyzed by the developed method, and endosulfan sulfate, 2,4-DDT, 4,4-DDT, 4,4-DDD and 4,4-DDE were detected at 1.3-444.9, 2.2-31.9, 4.5-863.1, 1.9-48.0, and 2.3-119.3 µg/kg, respectively. But OCPs in grape, peach, apple, and pear were not detected in all samples. These results showed that the residue in orchard soil were lower level than bioaccumulation occurring.

WE146 PhytoCOTE project: Assessment of organic and inorganic contamination in vineyard soils

M. Pierdet, LPTC EPOC UMR5805; J. Guillaud, University of Bordeaux / EPOC UMR 5805; M. Devier, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; L. Denaux, INRA BORDEAUX; H. Budzinski, University of Bordeaux Viticulture is one of the agricultural crops that uses the most important quantities of pesticides in France, in particular fungicides. These regular inputs may lead to a long-term contamination of ecosystems and thereby affect fauna and flora. Data on the processes involved are essential to play an important role in plant protection. In order to improve the knowledge about the evolution in time and scale of different chemical contaminants within different soil types, a state of contamination level in soil surfaces and a characterisation of trace element availability were assessed. 53 plots with important pedological diversity were sampled over the 0-15 cm horizon. The soils were characterised (organic matter, Fe and Al oxihydroxides, CEC, granulometry, pH and total copper, cadmium, lead, zinc and ZnOJ 205 organic molecules were measured. The characterisation of trace element availability was performed using passive samplers (Diffusive Gradients in Thin films). A copper contamination due to past and current uses of Bordeaux mixture (copper sulphate) has been put in evidence on the experimental site (until 197 mg/kg of dry soil). Concerning organic pesticides, a high diversity of molecules at different levels of concentration were found depending on crops. The results of the analyses will allow to show if: (1) the copper contamination level plays a role on the molecule degradation and contamination level; (2) the soil physical and chemical parameters play a role on the molecule degradation and on the copper and molecule retention; (3) the past and current soil uses impact the contamination levels.

WE147 Analysis and Assessment of Organic Contaminants in Materials Spread on Land in Scotland

E. Stuart, WCA Environment Limited; I. Wilson, G. Merrington, UK

Due to improvements in analytical capability increasing numbers of synthetic chemicals are being found in organic materials that may be recycled to agricultural land such as sewage sludge, animal manures, compost and digestate. Commonly occurring contaminants include pharmaceuticals, veterinary medicines, personal care products and persistent organic pollutants. Application of suitable organic materials to land is an attractive and apparently sustainable option that offers a range of agronomic and environmental benefits. However, there is a balance to be struck between the benefits of application to land and potential risks, such as the possibility of human and environmental health effects from trace constituents. It is critical that such consideration of this exposure pathway and any resulting regulatory decisions are risk-based and made using robust evidence and science. Previous assessments of risks posed by contaminants in materials applied to land generally have a very low risk assessment. The approach adopted under this project is to investigate the fate of priority chemicals in organic materials prior to spreading and the data will be used to undertake a refined risk assessment and to calculate a maximum safe spread rate for each material considered for application to land. Acknowledgements - The authors thank the Scottish Environmental Protection Authority (SEPA) for funding this work.

WE148 Microplastics in Agriculture Soil.

K.B. Olesen, Aalborg University / Department of Civil Engineering; N. van Alst, Aalborg University / Civil Engineering Department; A. Vianello, Aalborg University / Civil Engineering Department

Microplastic is an environmental pollutant of worldwide concern. However, neither microplastic concentrations nor their sources or sinks are completely known. This study presents the methods of sample preparation and presents field data. In Sweden 3 fields were sampled. Monitored amounts of sludge fertilizer. 40 kg of soil were sampled from each field. The microplastic sampling and analysis techniques are applied for microplastic identification. This requires two different IR spectroscopy such as micro fourier transform infrared (µFT-IR) spectroscopy and attenuated total reflectance (ATR) enables a reliable identification and quantification of microplastics. Studies show the tendency of microplastic accumulation in wastewater sludge. This sludge is used as fertilizer in agriculture farming. This study focuses on the occurrence of microplastics in the size range 5000-10 µm in soils that received wastewater sludge as fertilizer. It presents the methods of sample preparation and presents field data. In Sweden 3 fields were sampled. Monitored amounts of sludge fertilizer have been spread over a period of 35 years. The fields have either received 3 tons/year, 1 tons/year or no sludge fertilizer. 40 kg of soil were sampled from each field. The microplastic concentration is in general low; therefore the plastic needs to be extracted from other materials present. Of the microplastics, the size range of interest, two different IR techniques are applied for microplastic identification. This requires two different plastic extraction methods. Therefore, two sample protocols were developed ~ < 500µm and >500µm. More than 500µm of soil was dried and sieved through a 500µm metal sieve. To remove the organic fraction a gravimetrical separation method was used. For a sample of this size a custom made aerator-device was built. The samples and a sub-sample was ventilated with air for 1 hour ZnCl2 (density of 1.7 g/cm³). After 2 days the valve in the top chamber was closed and ZnCl2 was drained so the top chamber could be removed. The fluid from the top chamber was filtrated over a 10 µm steel device. The remaining particles were suspended in < 500µm and >500µm. More than 500µm of soil was dried and sieved through a 500µm metal sieve. To remove the organic fraction a gravimetrical separation method was used. For a sample of this size a custom made aerator-device was built. The samples and a sub-sample was ventilated with air for 1 hour ZnCl2 (density of 1.7 g/cm³). After 2 days the valve in the top chamber was closed and ZnCl2 was drained so the top chamber could be removed. The fluid from the top chamber was filtrated over a 10 µm steel mesh. The device was refilled with ZnCl2 and the agitation sequence was repeated. To remove the organic fraction the filtered material was treated with enzymes for several days and oxidised with H2O2. The remaining particles were suspended in ethanol and a sub-sample was deposited on a window and scanned by a state-of-the-art µFT-IR Imaging system (128x128 pixel Focal Plane Array (FPA) microscope detector). >500µm 10 kg of soil was wet-sieved through an 8mm, 6mm, 4mm, 2mm, 1mm and 500µm sieve. After the soil was dried it was floated in a

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ZnCl₂ solution. All floating particles were collected and individually analysed under a light microscope. Selected particles looking like plastic was analysed on the ATR.

WE149 Novel Analytical Strategies for Anthropogenic Compounds in Plants: Vegetable Biomonitoring for Subsurface Contaminants
R. Wahman, J. Grassmann, Technical University of Munich; P. Schroeder, Helmholtz Zentrum Munchen / Microbe Plant Interactions; S. Bieber, Technical University of Munich / Chair of Urban Water Systems Engineering; T. Letzel, Technical University of Munich

Plants play an important role in the maintenance of life. Besides providing us with food, plants are also a valuable tool for cleaning the environment. Whether it is water, soil, or compounds like dicyclofenac, which occur in water bodies in concentrations up to µg/L levels. The assimilated compounds are not excreted by the plants but stored in vacuoles. This project will focus on whether plants can eliminate pollutants from the environment and whether plants are capable of metabolizing the pollutants and to detoxify them.

These two points already have been partially clarified in phytoremediation research. However, a major problem related to this kind of research is not concerning the plant metabolism pathways, although knowledge about those pathways, the involved enzymes and the resulting transformation products is essential. Thus, our major goal was to figure out whether the biological degradation pathways can be reflected by the analytical data obtained from polarity extended RPLC-HILIC-MS analysis. There are several important research fields which give an original contribution to investigate the processes within biomolecules in leaf and root extracts of various plants. This study aims to contribute to this growing area of research by exploring new or modified secondary metabolites that appear after addition of pollutants. To the best of the authors knowledge, no research is available up to now that surveyed the changes in the plant metabolite pathways of constructed wetland plants (CWP). Moreover, along with growth in CWP, due to possibly accumulated contaminants that can be increasing concern about how those plants must be treated further, i.e. which points have to be considered regarding their disposal. We will provide a conceptual theoretical framework based on analysis of different plant extracts before and after exposure to different pollutants using novel RPLC-HILIC/ToF-MS technique. The plants were exposed in the laboratory to different pollutants. Initially, the prevalent dicyclofenac was chosen. After the plants reached their maturity, they were exposed to pollutants for a few days. To establish the concept at the beginning comparably high concentrations of pollutants were applied. Finally, we will be able to provide an open access database of plant metabolites (PHRAGMITES-IDENT) and implement it into an analytical platform constructed earlier (FOR-IDENT; see https://water.for-ident.org). This work is supported by the Bavarian State Ministry of the Environment and Consumer Protection.

WE150 Pharmaceuticals uptake by spinach from seven soils mixed with sewage sludge
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This study was focused on a mobility of pharmaceuticals from sewage sludge in soils and their uptake by plants. Soil samples were taken from top horizons of seven different soil types (Stagnic Chernozem Silite, Haplic Chernozem, Greyic Phaeozem, Haplic Luvisol, Arenosol Epieutric, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sewage were packed in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. After, a pond infiltration was applied and cumulative water outflow and solutes discharge from the bottom were measured. b) Spinach (Spinacea oleracea L.) was planted in soils mixed with sludge packed in plastic columns under greenhouse conditions. The amount of pharmaceuticals in plant parts (i.e., roots and leaves) was evaluated after harvesting. Compounds' discharges as well as their root uptakes were soil and sludge dependent. In general, mostly larger discharges were observed in the Arenosol Epieutric and Cambisols. Mobility of compounds depended on their sorption affinity to particular soil, but also on the contents of organic matter in the seeping solutions. Measured concentrations in spinach showed selective uptake of mobile pharmaceuticals in soil water. For instance estratine and carbamazepine were found in the discharged solutions and also in spinach. On the other hand, relatively large amount of fexofenadine and venlafaxine was found in the discharged solutions but very low or negligible concentrations were measured in the spinach parts.

WE151 Will spent mushroom substrate application affect the dissipation and plant uptake of phthalate esters?
J. Gao, Institute of Soil Science, CAS / Key Laboratory of Soil Environment and Pollution Remediation, CAS; F. Zhu, Institute of Soil Science CAS
To investigate whether spent mushroom substrate (SMS) amendment was an appropriate way to reduce di-(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DBnP) contents in soil and whether SMS could reduce DnBP accumulation in bock choy. A high concentration of non-sterilized SMS in soil and sludge dependent. In general, plant parts (i.e., roots and leaves) was evaluated after harvesting. Compounds' discharges, although knowledge about those pathways, the involved enzymes and the resulting transformation products is essential. Thus, our major goal was to figure out whether the biological degradation pathways can be reflected by the analytical data obtained from polarity extended RPLC-HILIC-MS analysis. There are several important research fields which give an original contribution to investigate the processes within biomolecules in leaf and root extracts of various plants. This study aims to contribute to this growing area of research by exploring new or modified secondary metabolites that appear after addition of pollutants. To the best of the authors knowledge, no research is available up to now that surveyed the changes in the plant metabolite pathways of constructed wetland plants (CWP). Moreover, along with growth in CWP, due to possibly accumulated contaminants that can be increasing concern about how those plants must be treated further, i.e. which points have to be considered regarding their disposal. We will provide a conceptual theoretical framework based on analysis of different plant extracts before and after exposure to different pollutants using novel RPLC-HILIC/ToF-MS technique. The plants were exposed in the laboratory to different pollutants. Initially, the prevalent dicyclofenac was chosen. After the plants reached their maturity, they were exposed to pollutants for a few days. To establish the concept at the beginning comparably high concentrations of pollutants were applied. Finally, we will be able to provide an open access database of plant metabolites (PHRAGMITES-IDENT) and implement it into an analytical platform constructed earlier (FOR-IDENT; see https://water.for-ident.org). This work is supported by the Bavarian State Ministry of the Environment and Consumer Protection.

Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress (P)

WE152 Experiences of demonstrating aquatic plant recovery following herbicide exposure using sloped mesocosms
F. Pickering, Cambridge Environmental Assessments

Recovery is important when considering short term exposure of aquatic non-target plants to herbicides in edge of field water bodies.Mesocosms studies allow the effects on both individual species and communities to be assessed simultaneously. Using indoor laboratory studies, where test item concentrations are artificially maintained, mesocosm studies allow for a more realistic application and dissipation of test item. Therefore, mesocosm studies can assess direct and indirect effects whilst a test item is present, and also monitor the period after dissipation has occurred to assess possible recovery. Using our sloped mesocosms at Cambridge Environmental Assessments (CEA), we are successfully able to test up to ten macrophyte species, each with different physical structures and characteristics (e.g. rooted; emergent). Some traditional measures of plant health can be seen as subjective (e.g. necrosis scoring and macrophyte mapping). At CEA, additional metric parameters such as number of nodes, number of leaves and stem lengths are routinely measured throughout the in-life phase. As a result, a combination of parameters are measured for each species tested. This ensures that the endpoints of a study are suitably robust and can be used to assess recovery. Here we will present results from our past studies to share experiences of assessing plant health. We will discuss which endpoints are most sensitive, reliable and therefore most suitable for determining effects on each plant species. Finally we will discuss which of these measurements are most relevant to assess recovery.

WE153 Impact of plant density on the end points (ER50) determined for crop protection products in Non Target Terrestrial Plants Studies conducted to OECD 227, Vegetative Vigour
E. Paterson, A. Thompson, Dow Agrosciences; G. Merecail, Dow Agrosciences Italia s.r.l. / Ecotoxicology; K. Ralston, Hoeper, Dow Agrosciences; G. Karauskis, AgaroSciences

Non Target Terrestrial Plant (NTTP) studies conducted to OECD 227 test guidelines are submitted as part of the registration process for plant protection products in Europe and the US. Current planting densities described in OECD test guideline 227 for Vegetative Vigour Studies, recommends 1-2 large plants per 15 cm pot, 3-5 medium size species per 15 cm pot and 5-10 small species per 15 cm pot. The minimum recommended number of plants per treatment in OECD 227 is 20, as a result vegetative vigour studies conducted to this guideline, regularly exceed 750 pots. These studies require a large amount of glasshouse space and are very labour extensive. Establishing, spraying, assessing and handling data from such large studies has its own issues and can increase the probability of errors occurring during the study which can be conducted in a given time frame; and increasing plant variability within the study making data interpretation more difficult. OECD 227 is a guideline and different planting densities, which are considered adequate to generate robust data, may be used. However it needs to be assessed whether these different planting densities in the pots can impact the final endpoints determined in the Vegetative Vigour studies and ultimately the risk assessment. Data will be presented at this meeting for several test species planted at three densities to assess any impact on the Vegetative Vigour Study endpoints (expressed as ER50 values) used in the risk assessment.
WE154
Interspecific competition impact on organism responses to chemical stress: an SSD-based approach.

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Organisms are not alone in the environment. They interact with other individuals of the same or other species in different ways. Interspecific competition is an important interaction for herbaceous plants in grass strips. Such vegetated areas generally act as buffer strips against pollutant flows and are thus submitted to various chemical exposures. However, competition is rarely considered in environmental risk assessment. To address this point, we tested whether competition modifies the way plants respond to herbicide (isoproturon) toxicity in an attempt to link individual tolerance of organisms and community dynamic. Then we investigated the impact of competition on species sensitivity distribution (SSD), a widely used community-level risk assessment tool that usually considers monospecific bioassays only. To do so, we exposed during 25 days 6 herbaceous species (representing varied isoproturon tolerance and competition ability) to 6 isoproturon concentrations (0 to 1.75µM) in presence and absence of a selected competitor, Bromus erectus (choice based on its high resistance to isoproturon and its high competition to grasses). For each competition, we replicated 2 species, e.g. by degree exposure or transport. In such cases, the plants might recover if the effects are reversible. Neglecting the recovery potential in the risk assessment is definitively protective but might be over-restrictive resulting in for example unnecessary losses of crop yields. The recovery subgroup of the SETAC Plants Interest Group aims to review the different approaches to analyse recovery of plants and to make suggestions how recovery should be included in a risk framework. In this presentation, we will focus on aquatic algae and macrophytes and the regulation of plant protection products in the EU. Experimentally, recovery of algae and macrophytes can be assessed in single species laboratory tests or micro- and mesocosm studies. In refined exposure laboratory toxicity tests, usually the recovery of the growth rate is assessed since the populations are kept in the experimental growth phase. In micro- and mesocosm studies, it is possible to analyse also recovery of abundance or biomass and potential indirect effects. The differences of these two options and their potential consequences for risk assessment will be discussed. Effect modelling can be used to extrapolate from empirical data to other exposure scenarios or species. However, while the simulation of refined exposure laboratory toxicity tests seems to be straightforward, the prediction of effects under field conditions is still challenging. In addition, the use of such models in the risk assessment requires clearer criteria on which magnitude and duration of effects can be considered acceptable.

WE156
Rimsulfuron toxicity and recovery in duckweed (Lemna minor) and rice plants.

M. Opincarc, University of Florida / School of Natural Resources and Environment; P.C. Wilson, Z. Li, University of Florida / IFAS / Soil and Water Science

Rimsulfuron is an herbicide for which very little is known about its toxicity to aquatic macrophytes. This study was designed to evaluate the effects of rimsulfuron on the model aquatic macrophyte Lemma minor at low concentrations. This study also evaluated recovery by L. minor following a 5 day exposure period. Growth rates were measured at 1, 3, and 5 days following exposure to rimsulfuron-fortified 10% Hoaglands media at concentrations of 0, 0.0003, 0.0006, 0.00125, 0.0025, 0.005, 0.01, and 0.02 mg/L. After 5 days exposure, growth rates were significantly lower for rimsulfuron concentrations ≥0.0006 mg/L. Following the 5-day exposure period, plants were rinsed with deionized water and placed in fresh Hoagland’s nutrient media. Impact on growth rate was measured as percent impact compared with growth of the control. Growth rates for 0.0006 mg/L were reduced 25.4% relative to the controls. Interestingly, a horometric response was observed at the 0.0006 mg/L concentration at day 5. In this case, the growth rate was 16.7% relative to the control. Following exposure, significant reductions in growth rate were observed on days 3, 5, and 10. However, 15 days after removal from the rimsulfuron treatment solutions, growth rates recovered to control levels. While rimsulfuron exposure significantly reduced growth rates of L. minor at all concentrations ≥0.0006 mg/L, effects were found to be reversible. Rimsulfuron was fast acting, with toxicity observed 1 day following exposure. In contrast, a longer period of time was required for growth rates to recover to control levels.

WE157
Toxicokinetics/toxicodynamic (TK/TD) modelling - Increasing the realism in risk assessment for aquatic plants

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For assessing the risk of plant protection products (PPP) to aquatic ecosystems, environmental concentrations of the active substance need to be estimated. Throughout Europe different approaches are used to predict these environmental concentrations on the basis of exposure patterns. For characterizing risks of active substances by TK/TD modelling as a powerful tool to evaluate effects of time variable exposure on aquatic plants. TK/TD modelling refers to linking effects to the internal concentrations in an organism instead of the external one and by this being able to consider time-variable exposure patterns. To characterize risks of active substances by TK/TD modelling, it is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship. Besides defining the parameters, it is also necessary to validate them by using the parameterized TK/TD model and by comparing predictions of the model to measured data. In this work, we present the validation/calibration results of a TK/TD model that was parameterized to describe the effects of different sulfonyleurea herbicides. The results demonstrate that the TK/TD Lemna model with its specific parameterization is able to reliably predict effects. Using the TK/TD Lemna model allows to perform a more realistic environmental risk assessment and to link time variable-exposure to effects.

WE158
Assessing soil toxicity of methylparaben using plants and collembola

D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

Methylparaben is an endocrine disrupting chemicals (EDCs) and is contained in many personal care products such as cosmetics and quasi-drugs. Methylparaben is known to have low toxicity to mammals, but there is no data on hazard assessment for soil ecosystem. Methylparaben was mostly removed in the sewage treatment process, but was detected in soils of various countries. In addition, there is a possibility that personal care products may leak into aquatic or soil environments if they are disposed of without any treatment. Therefore, it is necessary to evaluate the hazard assessment of methylparaben in soil ecosystem. This study assessed the toxicity of methylparaben to plants (mung bean and rice) and collembola. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collembola test, methylparaben was exposed at 0 to 500 mg/kg for 5 days and mortality was observed. The most sensitive endpoint in mung bean was identified as stomatal opening size, and no observed effect concentration (NOEC) was 10 mg/kg. The most sensitive factor in rice was chlorophyll contents, and NOEC was under 10 mg/kg. The half-lethal concentration (LC50) value for collembola was 440.53 mg/kg. Methylparaben appears to have significant physiological effects on plants even at low concentrations. The results of this study can be fundamental for soil risk assessments of methylparaben. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for
WE151

Evaluation of phytotoxicity for Bisphenol A with new endpoint, phytoestrogen
D. Kim, J. Kwak
Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

We determined the toxicity of chemicals (EDCs) as known chemicals that show hormone-like action or inhibit hormones, the phytotoxicity assessment of EDCs does not have any specific toxic endpoints for these substances. The factors (growth, photosynthetic activity, chlorophyll, etc.) used to evaluate common toxic substances such as heavy metals are also applied to EDCs. These factors are not suitable for EDC materials, which have relatively low toxicity to organisms, and plants may not show an abnormal phenomenon associated with their exposure, which takes a long time to assess toxicity. Therefore, we tried to evaluate phytoestrogen, a new toxic endpoint for EDC materials, using bisphenol A. Meanwhile, bisphenol A is known as a representative EDC used in the production of consumer products and in various industrial fields. While it is used widely for various purposes, the soil ecotoxicity of bisphenol A is limited. Therefore, we evaluated the toxicity of bisphenol A in three monocotyledonous plants using traditional endpoints and evaluated the applicability of phytoestrogen, a new endpoint for EDCs materials. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and funded by the Graduate School of Specialization for managing information related to chemical risk.

WE160

Soil toxicity of DEHP and Nonylphenol on mungbean and rice
D. Kim, J. Kwak
Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

DEHP is used as a plasticizer and insecticide. Especially, it can be used as plastic vinyl applied in farmland. Nonylphenol is used as surfactant, and 4-nonylphenol is mainly used substance with various isomers which are used as insecticide and detergent. Although DEHP and nonylphenol are likely to release into the soil environments, soil ecotoxicity data are currently limited. Ecotoxicological researches in soil were reported in only three cases of DEHP and four cases of nonylphenol. This study was conducted to evaluate the effects of DEHP and nonylphenol on the growth and physiological changes of mung bean and rice. The toxicity tests were conducted on 14 days (acute) and 21 days (chronic). Shoot growth was measured in 14 days-acute experiment and physiological factors including stomata opening size, chlorophyll content, and photosynthetic activity were evaluated in the 21 day-chronic experiment. This study is meaningful because the soil toxicity of the two substances to the plants was conducted using various factors, and the results of this study can be fundamental for soil risk assessments. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for managing information related to chemical risk.

WE161

Toxicity of a glycoside based formulation on phytoplankton green microalgae
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The emergence of transgenic crops led to an increase in the use of glyphosate and its presence in different ecosystems is a worldwide problem. Although it was designed to inhibit the aromatic amino acids synthesis in plants, glyphosate exerts toxic effects on non-target organisms, probably through other mechanisms. Its entry into waterbodies means a risk for biota, particularly for the phytoplankton microalgae communities. On the other hand, the results of this study can be fundamental for soil risk assessments of DEHP and nonylphenol. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for managing information related to chemical risk.

WE162

Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment
G. Mereghali, Dow AgroSciences Italia s.r.l. / Ecotoxicology; C. Vaj, V. Zaffagnini, A. Carone, Dow AgroSciences Italia srl

Indicator species are the basis of the ecological risk assessment framework. Endpoints derived for these species used in the risk assessment to evaluate the safety of, e.g. plant protection products (PPP) to non-target species. In certain cases indicator species are also indigenous species to a particular region (e.g. Myriophyllum spicatum in Europe). Invasive species are non-autochthonous species, accidently introduced in a given region, which, in absence of their natural predators, often grow uncontrolled and overcome indigenous species, completely devastating the biodiversity of the habitats they colonise. The uncontrolled growth of these species can be also a threat to ecosystem functioning, e.g. altering oxygen balance in the case of the aquatic environment or shifting the prey/predator equilibrium. In cases where other control means are not possible, PPP could be employed to control the spread of invasive species. As an example, in the USA some herbicides have been authorised to control M. spicatum, which is an invasive alien species in North America. On the other hand, recently in Europe there have been reports of Myriophyllum aquaticum, a new alien invasive species genetically related to the indicator M. spicatum. In Piedmont (Italy), M. aquaticum has been observed in the Po River, threatening aquatic biodiversity. In addition also rice cultivation, a very important crop for the region, is at risk, due to the uncontrolled growth of M. aquaticum in canals and ditches feeding water to rice paddies. This species has been added as an invasive species to the black lists of Piedmont and of the European Union and it is being monitored and controlled with local initiatives. To prevent the irreversible degradation or destruction of natural habitats by non-autochthonous species, a timely intervention may be necessary, even if this may result in a temporal impact on indigenous desirable species. Programs to manage invasive species need to be designed to restore natural habitats degraded by the presence of alien species. The use of a risk-benefit analysis, which can help in the decision of whether PPP are suitable for use in such programs, will be discussed in light of the two abovementioned examples.

WE163

Auxinic herbicides: the impact of water plants’ root measurements on the risk assessment
G. Gonsior, Eurofins Agroscience Services Ecotox GmbH

Data requirements for the registration of plant protection products in the EU Regulation 1107/2009 indicate that a test on a Myriophyllum species is necessary for auxinic herbicides. The OECD 239 water sediment test with Myriophyllum spicatum developed by the OECD working group was found comparable to natural conditions. In this testing methodology, shoot length, as well as, fresh and dry weights need to be recorded. The OECD 239 guideline requires that only a qualitative assessment of the roots is undertaken. Auxinic substances are known to exert their herbicidal activity by affecting growing tissues. As such, roots of Myriophyllum plants may be affected after exposure to auxins. The methodology described in the OECD 239 guideline can be adapted to include measurements of fresh and dry weights for whole plants, rather than just the shoots, thereby assessing, indirectly, also possible effects on the roots. However, it needs to be evaluated if an indirect quantitative assessment of the roots in the Myriophyllum studies with auxinic substances would result in significantly different endpoints that could be used as the basis for PPP risk assessment of auxinic substances. Results will be presented to clarify if effects on the roots in a water sediment system are providing additional information relevant for the risk assessment.

WE164

Testing the emergent macrophyte, Glyceria maxima in a water-sediment system: Results of a ring-test with Isoproturon
J. Davies, Syngenta / Environmental Safety; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; K. Kuhl, Bayer AG - Crop Science Division; J. Kubiriza, BASF. M. Ratte, ToxRat Solutions GmbH & Co. KG

Under EU pesticide regulation, regulatory tests are required for the aquatic macrophyte, Lemna, and two algal species for herbicides and plant growth regulators. Data requirements introduced under EU Directive 1107/2009 stipulate that further tests may be required for compounds which show selectively higher toxicity to either dicotyledonous or monocotyledonous plant species in terrestrial plant tests. In these cases, the recommended dicot and monocot species increases of reactive oxygen species, lipid peroxidation (TBARS), reduced glutathione, superoxide dismutase, and glutathione transferase. The level reached of TBARS in P kessleri was 10 times lower than in M. contortum, while the levels of antioxidant defenses were 3.5 - 7 times higher. These results suggest that oxidative stress would be involved in the toxicity of the glyphosate formulation and that the differences in sensitivity between strains could be due to differences in their defense antioxidant levels. According to the EU Directive 93/67/EEC, the IC50 values estimated indicate that the glyphosate formulation assayed should be toxic for aquatic biota. Besides, results also warn about its possible effects on the composition of phytoplankton, which would put at risk the balance of the aquatic ecosystem.
are Myriophyllum and Glyceria, respectively. OECD Test Guideline 239 for testing Myriophyllum spicatum in a water-sediment system was adopted in September 2014 and this test method has since been adapted to facilitate growth of the emergent, reed grass, Glyceria maxima. During 2016 and 2017, 15 laboratories participated in a ring-test with the herbicide, isoproturon against Glyceria. The objectives of this test were to establish suitable test conditions, to determine the required test duration, to characterize control variability and inform test design and to identify appropriate validity criteria. Results of this ring-test will be presented alongside progress on a second ring-test with the herbicide imazamox, scheduled for Spring / Summer 2018.

**WE165**

**Study of the toxicity effects of Cd, Ni and Zn on macrophytes, antioxidant responses and time for steady-state bioaccumulation under constant metal concentrations exposures**

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Heavy metals represent an actual environmental problem because the industrial and commercial uses of them are continuously increasing, bringing on a widespread contamination. Examples of human activities that contribute in heavy metal contamination are mining, smelting, fossil fuel combustion and industrial applications. Human activities may also indirectly cause changes in the environment that mobilize metals that were otherwise bound in stable forms, making them bioavailable. Aquatic bodies directly or indirectly receive pollutant discharges and metals in waters are easily absorbed by organisms. This study was aimed to evaluate the individual toxicity effect of Cd, Ni and Zn on a macrophyte and its bioaccumulation capability. Cadmium is a hazardous environmental pollutant and is toxic to most organisms. Nickel and Zinc are essential trace elements needed in the nutrition of plants. Nevertheless, over certain threshold they can present phytotoxic activity. Macrophytes are key elements in aquatic ecosystems and can be used as a bioindicator for monitoring environmental quality. Ceratophyllum demersum. Following the OECD 2014 guideline for sediment-free toxicity test, plants were exposed to a range of concentrations (1-6 Ni, 4-64 Zn or 0.5-8 Cd mg/L) and fresh weight, main shoot length and total shoot length were chosen as endpoints. For the bioaccumulation assays, plants were exposed to a constant metal concentration, in periods of time until internal metal concentration reached a steady state. To make sure of a constant external metal concentration, a daily renewal of the media was carried out. Besides, the influence of these metals on antioxidative enzymes activity was evaluated for the three lower concentrations of each one. These enzymes are involved in the plant defense mechanisms activated by heavy metal exposure. Determination of catalase (CAT), glutathione peroxidase (GPOX) and ascorbate peroxidase (APOX) enzymes were performed from the total plant mass. In the main, fresh weight resulted in the most sensible endpoint reaching an inhibition of almost 50% for 64 mg Zn/L and presenting significant inhibition for concentrations higher than 2 mg Ni/L and 1 mg Cd/L. Cd exposed plants over 1 mg/L presented signs of chlorosis and disaggregated easily at the higher concentrations. Metal uptake reaches the steady-state between days 11-14 in all cases. CAT activity at test concentrations remained near control values, while APOX and GPOX enzymes showed an increase indicating possible sublethal effects.

**WE166**

**Physiological responses of Thlaspi prae cox (Brassicaceae) to Ni hyperaccumulation**

T.D. Mišljenović, K. Jakovljević, S. Jovanović, University of Belgrade / Faculty of Biology Institute of Botany and Botanical Garden Jevremovac; N. Mihailović, University of Belgrade / Institute for the Application of Nuclear Energy; V. Maksimović, University of Belgrade / Institute for Multidisciplinary Research; D. Mišić, University of Belgrade / Institute for Biological Research Sima Stanković Thlaspi prae cox is a well known heavy metal hyperaccumulating plant species. The ability of T. prae cox to hyperaccumulate Zn and Cd have been extensively studied, while data on Ni hyperaccumulation are scarce. Our aim was to bring more understanding to the physiology of T. prae cox exposed to increasing concentrations of Ni. Seeds of T. prae cox were collected from an ultramafic site on Mt. Maljen (Serbia). Two - weeks old seedlings were planted to a peat based substrate amended with increasing concentrations of Ni (250, 500, 1000 ppm). Plants were grown for 3 months under controlled conditions. Content of Ni in plants was analyzed by AAS, while phenolics, sugars and organic acids have been analysed using UHPLC/DA MMS® or HPLC-PAD. No visible toxicity symptoms were observed during plant growth, and Ni did not affect biomass production at applied concentrations. A dose-dependent response of T. prae cox shoots to applied Ni concentrations was recorded. Ni hyperaccumulation threshold of 1000 ppm was exceeded in the shoots at all treatments, and the highest Ni content was 6786 ppm. Calculated values of translocation factor (shoot/root ratio of Ni concentration) above 10 in all Ni treated groups indicated active translocation of Ni from roots to the shoots. At the highest applied Ni concentration, statistically significant reduction of total chlorophyll content and carotenoids were observed. Contents of phenolic acids and flavonoids were generally low, and were not significantly affected by increasing Ni concentrations. Effects of increasing Ni concentrations on the content of sugars and organic acids in shoots have also been analyzed.

Understanding the physiology of T. prae cox exposed to Ni and its’ Ni tolerance limits might be relevant for the potential application of this species in phytostabilization or phytorextraction technologies at contaminated soils.

**WE167**

**Phytoextraction of heavy metals in Cienega of Tamasopo wetland, Mexico, by Typha latifolia C. Wong, C. Carranza, Universidad Autonoma de San Luis Potosi / Laboratorio de ciencias ambientales; A.J. Alonzo, Universidad de Guanajuato / Departamento de Farmacia**

Heavy metals are persistent inorganic toxic pollutants that come from diverse anthropogenic activities [1]. They can be easily absorbed by the roots of plants due to their relatively high mobility in the soil and as a result they are known to have great importance, forming a substantial component of the primary production in many aquatic ecosystems, especially in wetlands. Plants can remove and accumulate metals from the solution by phytorextraction; however, the metals can also be precipitated or eliminated from the solution by ion exchange or by adsorption on organic and inorganic compounds. Concentrations of heavy metals in aquatic plants depend both on metal speciation and on the species of plant absorbing the metal [2]. High concentrations of some trace metals in aquatic plants have led many authors to believe that they accumulate from water and/or from sediments; the uptake is influenced by several factors, such as temperature, pH, light and the presence of other metals in the water, all of which alter the uptake of heavy metals into the tissue [3]. Metal uptake by plants has three patterns: (1) true exclusion in which metals are removed from entering the plants; (2) shoot exclusion, in which metals are accumulated in the root but translocation to the shoot is restricted; and (3) accumulation, where metals are concentrated in the plant parts [4]. The present research examines the phytorextraction in situ of heavy metals by Typha latifolia to determine the concentration of these metals in the plant, water and sediments. The experimental procedure consisted of: 1) sampling of five sites of the Cienega de Tamasopo wetland where Typha latifolia was free to grow naturally; 2) taking 3 samples of 5% acidified water with HNO3; and one sample without acidification for physicochemical parameters, one sample of the first 10 cm of sediment; 2) plants: washing, separation in roots and leaves and drying at 70 °C for 18 hours in Lindberg / Blue stove; 3) grinding and spraying of root and leaves in analytical mill (KIKA Werke M20); 4) acid digestion with HNO3 in plate at room temperature of root and leaves [5] and sediments; 5) quantification of heavy metals by ICP-MS in digestion and water column samples. The results show that Typha latifolia accumulate Mn> Zn>Cr>Pb>Cu>A> Hg>Cd in roots. This study aimed to gain a better understanding of the importance of aquatic plants such as Typha latifolia in heavy metal accumulation and detoxification mechanisms.

**WE168**

**Heavy metal removal by aquatic plants**

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Removal of heavy metals from the environment due to industrialization and urbanization is a great problem worldwide, due to their toxicity to many life forms. Aquatic waste from metal plating, mining operations, tanneries, smelting, alloy industries, and storage batteries are sources of metal contamination. Biological methods have been recommended as effective alternative for removal and recovery of heavy metals from aqueous solutions. Aquatic plant biomass represents an important biological resource for metal accumulation. In addition, aquatic plants can accumulate heavy metals and therefore have been exploited worldwide in the field of wastewater treatment technologies. Aquatic plant species including free floating or submerged, as Lemna, Spirodella, Ceratophyllum and Myriophyllum, have shown potential for metal removal from wastewater. The aim of this study is to evaluate the efficiency and capacity of different species of aquatic macrophyte in removing heavy metals from an artificial wastewater in a multi-metal system. At these time intervals, samples of water, root and leaves of Typha latifolia were collected. Acute toxicity test with the green alga P. subcapitata, acute toxicity test with D. magna and ex vivo cytotoxicity test with E. foetida coelomocytes. An experiment was set up for 10 days, by the addition of 10 grs of fresh weight of plants from different species mentioned above, in the metals solution. Previous works have shown that metal uptake rates were faster within the first 48 hours, and decrease with time and with metal concentration solution, so, at this time and at 3 and 5 days, respectively, plants were removed and new plants were placed in the same multi-metal system. At these time intervals, samples of solution and plant were taken for metal determination. The harvested plants were dried in an oven room and a microwave acid digestion were carried out. Metal determinations in aqueous and plants sample were made by flame atomic absorption spectrometry. There was a gradual decrease in metal contents in the artificial wastewater at time intervals. The metal removal capacity was different for each species and for each metal. At the end of the experiment, the multi-metal system treated with aquatic plants was assessed with the same battery of tests used in the beginning. The whole ecotoxicity of the artificial wastewater decrease after treatment with aquatic plants, demonstrating an efficiency of 81% for metal removal and recovery.
WE169
Toxicity of the binary mixture Cd-Zn on Lemna gibba evaluated using morphological and oxidative stress enzyme endpoints
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The presence of metals in the environment represents one of the major concerns as they are persistent in nature, non-biodegradable and can bioaccumulate in living organisms and plants. Metals in aquatic ecosystems may have significant ecological trophic level composed partly by aquatic vascular plants, also called macrophytes. These organisms play a critical role in this environment. As a representative species of macrophytes, we worked with a rooted free-floating Lemna gibba. The metals evaluated here were Cd and Zn, individually and in mixtures. Exposures of plants were carried out in presence or absence of Cd and Zn for 7 days. Different endpoints were determined at the end of the assays. Number of fronds, fresh weight, fronds/colonies ratio, frond area and exes' length were the determined morphological endpoints. Physiological changes were evaluated as enzymatic activity of catalase, ascorbate peroxidase and guaiacol peroxidase, determined at the lowest concentrations. Both metal concentrations, bringing about a 50 % inhibition of final number (EC50) was determined. In order to compare the sensitivities of the different endpoints, NOEC and LOEC toxicity indexes were calculated. For Cd, fresh weight and fronds/colonies ratio resulted in the most sensitive, while for Zn total area was the most sensitive. Even though there was no significant difference for guaiacol peroxidase activity for Cd, it presented an increase compared to control. While the other enzymes had activity levels similar to the control. In the case of Zn, catalase and ascorbic acid peroxidase activities were higher, however neither of both presented significant differences with it. For the mixture analysis, multiple regression was used to find the observed %frond number inhibition (%FNI) to dissolved metal concentration (M(1,1)). The negative value of the parameter of the interaction between Cd and Zn indicates alleviation of %FNI and toxicity. The concentration addition approach was evaluated by calculating the sum of dose responses on single EC50-values for each mixture, the average ∑TU of all test cases resulted 1,13 suggesting that this mixture presents an additive toxicity to Lemna gibba. Enzyme activity was also calculated at the lower concentrations of the mixtures. In general an increase in the enzymatic activity was observed. Ascorbate peroxidase and guaiacol peroxidase presented the maximum increase, while catalase had a moderated activity rise.

WE170
Increase of tolerance of green algae as a tool in metal bioremediation
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Presence of various metals in aqueous streams arising from the discharge of untreated metal containing effluents into water bodies, is one of the most important environmental issue, as human health risks and harmful effect to living organisms occur. In the last decades the amount of Chromium in aquatic and terrestrial ecosystems has increased as a result of different human activities such mining, chrome plating, leather tanning and others. It has been reported that Chronic stress inhibits growth, metabolic activity, respiration and photosynthesis in algae. In this study, we intended to evaluate the use of preadapted strains to subletal concentrations of Chromium, into bioremediation of Chromium containing wastewater. Preliminary results will be shown related to the assessment of the potential of this strategy to increase tolerance of selected species in order to become an interesting tool in the field of bioremediation processes mediated by green algae. Two green algae species were used: Nannochloris oculata and Phaeodactylum tricornutum. These two species differ in its morphological structure and organization level as the former has a cenobial feature while the second a free unicellular one. Both strains were maintained by a year under subletal concentrations of chromium ranging from 0.42 to 73 mg/l. These concentrations were chosen base on previous experiments through range finding tests. Subletal solutions were renewed monthly and algal cells were subcultured in new medium. After the preadapted period, each subletal exposed algal population from both strain and one which was never exposed to the metal, considered as the control, were centrifuged. An inoculum of know cell density was prepared with each pellet, and the algae were exposed to a wide range of Chromium concentrations. Samples of solution and algal cells were taken for metal determination in order to elucidate the mechanism of resistance origin. The harvested cells were centrifuged and a microwave acid digestion were carried out. Metal determinations in subletal solutions and in algal sample were made by flame atomic absorption spectrometry. Chromium accumulation and compartmentalization in algal cells would explained the increase resistance observed. Further studies relative to detoxification mechanisms and chelating internal molecules as phytochelatin will be conducted to unravel the tolerance mechanisms involved.

WE171
Ecotoxicological assessment of the iron mining waste from Mariana (Brazil) on terrestrial flora using different plant species
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In Brazil it is very common to have mining waste placed in dams, especially in the Minas Gerais state. The deposit of mining wastes implies in risk of dam rupture, between other problems. In November 2015, the rupture of the “Fundão” Dam in the city of Mariana in Minas Gerais state was one of the worst environmental disasters in Brazil. The rupture caused severe impacts to the terrestrial and aquatic environments, where tons of the waste has been placed. It is now matter of concern to study the effects of the mining waste deposition in soil to terrestrial flora in order to understand the real consequences to the environment and so be able to propose actions for restoration and management of the affected area. The main goal of this study was to evaluate the ecotoxicity of the mining waste that outpoured the Fundão dam to ten different plant species (Avena striosa, Pennisetum glaucum, Croatia juncus, Canavalla ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The ecotoxicological assays followed the OECD guidelines for the mixture of a natural soil (NS) from Mariana (uncontaminated) and the waste (W). The combinations of mixture were: P1: 75% NS and 25% W; P2: 50% NS and 50% W; P3: 25% of NT and 75% of the W and P4: 100% W. The parameters evaluated were: Fresh and dry biomass (shoot and root), height, length of the longest root and seed emergence. All species, except Lupinus ulmus and Avena striosa, had EC50 and/or EC10 in at least one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. juncus (73.07%), P. glaucum (82.68%) and C. cajan (97.54%). The height of the first two species was affected by 20% in the proportions 78.61 and 85.91, respectively. The proportions 87.32 and 40.61% of waste affected 50% of the length of the longest root of C. juncus and P. glaucum. The results showed that: the species tested presented different indices to soil fertility by mining waste; the viability of seedlings of the Euphorbias induced long term toxic effects for all tested species; the most sensitive and least sensitive parameters, respectively, were root growth (root length and dry biomass) and seed emergence.

WE172
Mitigation of CuO nanoparticles microbial ecotoxicity by plant in an agricultural soil: plant variety matters
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New types of pesticides based on nanoparticles (NPs) are now being used to optimize phytosanitary treatments. However, they can generate soil contamination by metal-oxide NPs such as CuO-NPs (1) which fate and impact on agro-ecosystems is still largely unknown. Several studies showed the deleterious effects of metal nanoparticles (NPs) on soil microbial communities (2) and reported the importance of plant-soil-matter (OM) ecotoxicity (3). The aim of this research is to evaluate the stabilizing agent effect of CuO NPs on soil microbial communities. A high OM content is likely to increase NPs toxicity by favoring their dispersion. Based on this assumption, our goal was to assess 1) whether the plant modifies the microbial ecotoxicity of NPs because of organic matter enrichment in the rhizosphere through the root exudation and 2) whether the plant variety mitigates the ecotoxicity according to plant traits. Endpoints that relate to soil fertility by mining waste; the viability of seedlings of the Euphorbias induced long term toxic effects for all tested species; the most sensitive and least sensitive parameters, respectively, were root growth (root length and dry biomass) and seed emergence.

WE173
Use of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure
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and to its capability to accumulate certain environmental metal pollutants, would be a potentially valuable bioindicator species of metal pollutants. Mercury represents one of the most abundant marine pollutants in the Mediterranean Sea. In this study sublethal effects of this metal were investigated in P. oceanica. Several foliar shoots of this aquatic plant were treated for 4 days (96 h) with different mercury concentrations (0, 0.1 and 1 µg L−1 Hg Cl₂) under constant laboratory conditions. Biochemical markers of oxidative stress, such as glutathione S-transferase activity, the ascorbate peroxidase activity, the total antioxidant capacity, the phenols content, the level of lipid peroxidation and the microurethelial frequency were measured in different parts of adult leaves: the blades and the sheaths for antioxidant responses, the meristem and the sheaths for genotoxic effects. Although a limited effect of Hg was measured in analyzed tissues, a significant difference in localization of responses was found in leaves of all treatments.

WE174
Influence of tolune vapor exposure on plant metabolic changes
W. Kim, J. Park, Gwangju Institute of Science and Technology / School of Earth Sciences and Environmental Engineering; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

The conventional damage diagnosis methodology for plants after chemical accident only relied on the change in their phenotype such as leaf-browning, so there had been lots of controversy because of uncertain causality and inaccuracy. The ministry of environment tried to characterize of plant damage by introducing metabolomics. Toluene is a hazardous, odorless, flammable, colorless liquid. However, target metabolite selection process was unclear and the exposure method did not reflect the chemical accident scenario, so the research results have not been put to practical use. Therefore, untargeted metabolomics and vapor exposure chamber were introduced in this study to overcome the limitations of existing research. The development potential of metabolomics-based damage diagnosis tool was demonstrated using Pteridium aquilinum, and Hypericum adunum. Toluene was selected as target compound based on the scoring system, which takes into account both accident frequency and hazards. To reflect the realistic chemical accident scenario, plants were exposed in vapor exposure chamber. In this study, the metabolomics responses of plants at early development stages (4th leaf stage) to toluene were evaluated by liquid chromatography quadrupole time-of-flight mass spectrometry (LC-QToF-MS) based untargeted metabolite profiling. The exposed concentration-based and recovery time-based metabolic response patterns were analyzed by Principal component analysis and Partial least squares Discriminant Analysis. Overall, the results of multivariate statistical analysis demonstrated a number of potential biomarkers that were characterized by metabolicomic approach and provided an insight into quantitative chemical accident damage assessment.

WE175
Influence of soil organic amendments on the phenolic contents in rosemary and provided an insight into quantitative chemical accident damage assessment. compounds in the rosemary plants grown in the different treatments. The results obtained have shown that the incorporation of the organic amendments into the semiarid soil improved soil characteristics, by increasing organic matter and nutrient contents, but also implied a decrease in the concentrations of phenolic

Environmental Risk Assessment in Sediments (P)

WE178
Benthic invertebrate bioturbation activity determines species specific sensitivity to sediment contamination
M. de Baat, University of Amsterdam / IBED-FAME; T.V. van der Meer, University of Amsterdam / IBED-FAME; University of Freshwater and Marine Ecology; P. Verdonschot, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBED-FAME

Bioturbation activity of sediment-dwelling organisms promotes the release of contaminants across the benthic-pelagic ecosystem boundary, thereby affecting the exposure to and uptake of sediment associated contaminants at the sediment-water interface by themselves and the entire community around them. This way, bioturbation activity may contribute to species specific sensitivities to sediment associated compounds. Therefore we assessed if invertebrate bioturbation activity determines species specific sensitivities to sediment contamination. For two metals, Ni and Cu, sufficient data were available to construct Species Sensitivity Distributions (SSD). The position of the species in the SSDs could indeed be linked to their bioturbation rate: the most active bioturbators being the most sensitive benthic invertebrates. Active bioturbators thus enhance their exposure and therewith their sensitivity to sediment associated toxicants. Moreover, active bioturbators can hence promote the release of sediment-associated contaminants across the benthic-pelagic ecosystem boundary, thereby stimulating delivery of contaminants from what is often the most polluted environmental compartment in freshwater ecosystems. It is concluded that trait based ecotoxicology offers a possibly potent tool for predicting sensitivity of benthic invertebrates and the benthic community to sediment-associated contaminants.

WE179
Effect based sediment quality assessment incorporating chemical fingerprinting
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Freshwater and Marine Ecology

The European Union Water Framework Directive does not require member states to monitor sediment quality. When performed at all, water authorities most often monitor sediment quality by means of chemical target analysis focusing only on target compounds, potentially overlooking ecotoxicological risks caused by (un)known mixtures of sediment associated compounds. Hence, there is an urgent need to incorporate effect-based monitoring and chemical fingerprinting into sediment quality assessment. Therefore, the aim of the present study was to innovate ecotoxicological sediment quality assessment by incorporating whole sediment bioassays and chemical fingerprinting of bioavailable compounds. To this purpose intact whole sediment cores were collected using a sediment core sampler at a reference and 11 contaminated sites grouped by land use: urban, agricultural, and WWTP sites (WWTP = wastewater treatment plant) at each of the 11 sites. A Chironomus riparius 28-day life cycle whole sediment bioassay was performed with survival and emergence as endpoints. Simultaneously, SPME fibers were applied as sediment passive samplers to determine pore water concentrations of phenanthrene and pyrene, selected as model compounds for sediment PAF concentrations. Survival in the bioassay was unaffected at the urban sites, while significantly lower at all WWTP sites and two of the agricultural sites. Emergence was significantly delayed at the urban sites, agricultural sites exhibited an irregular emergence time, while WWTP sites induced accelerated emergence. Pyrene and phenanthrene concentrations were negligible at the reference site, very low at the agricultural and WWTP sites, and highest at the urban sites. Urban sites thus have a high chemical load, but survival was higher than on the agricultural sediments. Contrarily, agricultural and WWTP sites exhibited reduced bioavailability of the tested compounds. The SPME concentrations were comparable to the results of the whole sediment bioassay. In natura, X. Xia, X. Zhang, School of Environment, Beijing Normal University In natural rivers, hydrophobic organic compounds (HOCs) are mainly associated with particulates, especially for the rivers with high suspended sediment (SPS) concentrations. Suspended sediment will affect the bioavailability of HOCs in rivers. However, research has been carried out to quantify the bioavailability fraction of HOCs sorbed on different compositions of SPS with various particle sizes. In this study, we chose pyrene as a typical HOC to study the bioavailability of HOCs associated with SPS of various compositions and grain sizes to D. magna. The passive dosing devices were made to control the freely dissolved concentration of the bioavailable pyrene in the exposure systems. The effect of pyrene associated with SPS of different compositions (including amorphous organic carbon, AOC; black carbon, BC, and minerals) and grain sizes (including 0–50 μm, 50–100 μm, and 100–150 μm) on the immobilization and enzymatic activity of D. magna was investigated to quantify the bioavailability of SPS-associated pyrene. The results showed that with C\text{\textsubscript{S0}}, of pyrene ranging from 20.0–60.0 μg L\textsuperscript{-1}, the immobilization of D. magna in the presence of 1 g L\textsuperscript{-1} SPS were 1.11–2.89 times that in the absence of SPS. The contribution of mineral–organic carbon to pyrene bioavailability of SPS-associated pyrene was approximately 50–60%. 10–29%, and 20–30%, respectively. The bioavailability fraction of pyrene sorbed on the three components of SPS was ordered as AOC (22.4%–67.3%) > minerals (20.1%–46.0%) > BC (9.1%–16.8%). This is because the SPS composition will affect the sorption of pyrene in water as well as the desorption of pyrene from SPS in Daphnia magna. The immobilization caused by pyrene associated with different grain size SPS was ordered as 50–100 μm > 0–50 μm > 100–150 μm. When pyrene was 20.0 μg L\textsuperscript{-1}, the immobilization caused by pyrene associated with 50–100 μm SPS was 1.42 and 2.43 times that with 0–50 μm and 100–150 μm SPS, respectively. The protein and enzymatic activities of Daphnia magna also varied with different compositions of SPS. The effect of SPS composition on the bioavailability of SPS-associated pyrene was mainly due to the differences in SPS ingestion by Daphnia magna and SPS composition, especially the organic carbon type, among the three sizes. According to the results obtained in this study, a model has been developed to calculate the bioavailability of HOCs to aquatic organisms in natural waters considering both SPS grain size and composition. Sediment quality assessment is often based on chemical analysis only, occasionally including toxicological assays. Full sediment quality assessment, including chemical and macrofauna analysis and toxicological assays, is not the standard procedure due to high costs. Based on chemical analysis only, it is not always clear whether sediment management in form of dredging and landfill or remediation is necessary. To reduce costs of sediment management on the one hand and to increase environmental benefits on the other, the right priorities need to be set. To do so, insight into the impact of various sediment characteristics and the behavior and physiology of the affected organisms. Hence, bioavailable concentrations, rather than total metal concentrations, are often the critical factor in sediment risk assessment. Determination of bioaccumulation in organisms is a frequently used indicator for bioavailability. However, active and passive biomonitoring techniques are often time consuming and highly dependent

WE181 Sediment quality assessment in the Netherlands: Link between chemical, toxicological and ecological parameters L. Lautz, Radboud University Nijmegen / Department of Environmental Science; J. Chai, Radboud University Nijmegen; R. Hoosdert, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragaas, Radboud University / Department of Environmental Science; R. Van Zelm, Radboud University / Department of Environmental Science; J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science
on the exposed organisms, limiting comparability and standardization. Diffusive gradient in thin films (DGT) passive sampling is an innovative technique, allowing for the time-integrated measurement of potentially bioavailable metals in sediments or surface water. Divalent metals are selectively accumulated onto a Chelex-embedded hydrogel layer, providing a measurement of labile and weakly-bound metals. To evaluate DGT passive sampling measurements as a potential indicator of bioaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flon (Geneva), in a freshwater and 3 brackish aquatic systems. Bioavailability of metals will be assessed by active biomonitoring through a 4 weeks exposure of caged macroinvertebrates, after which bioaccumulation will be determined. The organisms will be exposed both at the sediment water interface and in the water column. During a pilot study, carried out in November 2017, 3 bivalves and a polychaete worm are exposed in the Zenne river (north of Brussels) to test for their active biomonitoring applicability. During the 4 weeks exposure period, DGT passive samplers will be deployed 3 times for a period of 24h at the sediment water interface and in the water column. Relationships will be determined between the bioaccumulation in the exposed organisms and the determined DGT fluxes. Bioaccumulation and passive sampling measurements as the sediment water interface and in the water column will be evaluated. The experiment aims at establishing relationships between bioaccumulation in different macroinvertebrate species and passive sampling measurements, and further validating the DGT passive sampling technique as a monitoring tool for sediment quality assessments in both freshwater and brackish aquatic systems.

WE184 Bioturbation in contaminated sediments: effects on exposure, toxicity and biogeochemistry.
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Sediments are a major sink for a range of contaminants. Organism-sediment interactions such as bioturbation can alter sediment physicochemistry, and facilitate the diffusion of reactive chemical species (e.g. O2) into deeper sediments, potentially changing the oxidation state of various redox-sensitive materials and the fate and toxicity of contaminants. We applied multidisciplinary to: (i) characterise influences of bioturbation on contaminant fate, exposure and toxicity to aid current sediment quality assessment frameworks; and, (ii) assess the potential use of bioturbation in the management and natural recovery of heavily degraded sediment ecosystems. Increased bioturbation in predominantly metal-contaminated sediments increased bivalve (Tellina deltoidalis) and amphipod (Victoriopsia australiensis) survival from 53% to 100% and 42 to 93%, respectively; and reproduction in a second amphipod (Melita plumularia) from 3 to 65%. This was attributed to the decreased concentrations of dissolved copper in the overlying water associated with bioturbation. Conversely, increased bioturbation in sediments contaminated by metals and hydrocarbons decreased reproduction (44 to 23%), which was attributed to an increased release of polycyclic aromatic hydrocarbons (PAHs). High-resolution chemical imaging dissolved oxygen and metals in a legacy contaminated sediment mesocosm with a bioturbator present showed the inhibition of metal oxidation. Waters within a few centimeters of the sediment-water interface, where organism-induced fluxes of nickel and zinc into burrow and overlying waters. The presence of nickel and zinc in burrow and overlying waters demonstrated that organism exposure is likely to be greater from the burrow waters than from the pore waters. This is consistent with increased accumulation of zinc observed with co-habitation of bivalves and amphipods. Low copper and lead concentrations in burrow waters during bioturbation events was consistent with the results of previous tests, where copper concentrations were lower in the presence of high bioturbation intensities, possibly due to binding with iron-(oxy)hydroxide phases or to respired particulate phases. These results highlight the importance of considering organism-interactions during sediment quality assessments, and the contributions they have to biogeochemistry and contaminant exposure to surrounding ecosystems.

WE185 The diffusive gradients in thin films (DGT) technique predicts toxicity of nickel contaminated sediments to a marine amphipod
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M. Gillmore represents an integrated approach to the biogeochemical fate and transport of contaminants. A field study was conducted in 2017 in the Vidy Bay of Lake Geneva, Switzerland, where a large portion of stormwater from the city of Lausanne via the Flon River, receives a large portion of stormwater from the city of Lausanne via the Flon River. In this context, this study aimed to evaluate the impact of the Flon river stormwater overflows on the sediment quality of the Vidy Bay using a triad approach combining chemistry, ecotoxicology and the study of in situ benthic communities.

WE186 Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using a integrated method of TIE and EDA
J. Yang, H. Li, F. Cheng, Jinan University / School of Environment and Ecology; B.J. Ferrari, Centre Ecotox EAWAGEPFL / Lyon; M. Alencastro, École Polytechnique Fédérale de Lausanne / Central Environmental Institute; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; M. Campillo-Martinez, T. Benejam, R. Vivien, Centre Ecotoc; S. Pesce, Istea Lyon-Villeurbanne / Microbial ecology of anthropised river systems; L. De Alencastro, École Polytechnique Fédérale de Lausanne / Central Environmental Laboratory; N. Dubois, Eawag; L. Rossi, Hydrique Ingénieurs; S. Höss, Ecossa / Animal Ecology; B.J. Ferrari, Centre Ecotox EAWAGEPFL / Lyon.

The SH (oxy)hydroxide phases or labile nickel as measured by DGT and further supports its use in nickel toxicity tests using SH-SYSY) were used to distinguish toxicants related to metabolism dysfunction, endocrine disruption, respiratory toxicity and neurotoxicity, respectively. Test sediment samples showed significant cell proliferation of SH-SYSY) to cause a 50% impairment in reproduction (EC50) had 24.5 mg/kg Ni) to cause a 50% impairment in reproduction (EC50) and Site 2 (1300 mg/kg Ni) had reproductive responses of 88% (±10) and 71% (±1) of the control, respectively. The EC50s based on DGT-labile Ni were 2.3 (1.7-3.4), 3.3 (1.7-4.9) and 2.0 (1.3-3.0) mg/m3 for silty, sandy-silt and sandy sediments, respectively. Conventional sediment TIEs methods of DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (0.4 mg/m3 DGT-labile Ni) and Site 2 (1.0 mg/m3 DGT-labile Ni) sediments, respectively ourapplied tests were performed. Bioaccumulative contaminants in sediment samples were extracted by XAD resin. Cell viability of the extracts was assessed by the cell counting kit-8 assays. To take tissue specificity into consideration, four cell lines (Hepg2, MCF-7, A549 and SH-SYSY) were used to distinguish toxicants related to metabolism dysfunction, endocrine disruption, respiratory toxicity and neurotoxicity, respectively. Test sediment samples showed significant cell proliferation of SH-SYSY) cell line, but little effect on Hepg2 and A549 cell lines. The results were further confirmed by toxicity tests using C. ciliatus. One sediment sample impacted MCF-7 cell line. The proliferation of SH-SYSY) proliferation was partially explained by oxidative stress. The SH-SYSY) cell line was used for further EDA experiments after separating the extracts into 35 fractions using GPC and NPLC. In conclusion, an integrated method of TIE and EDA would provide an environmentally relevant and toxicant specific approach to effectivly determine cause of sediment toxicity by combining the merits of the two methods.

WE187 Water discharges from the city of Lausanne during rainfall in Lake Geneva: Use of a triad approach as an indication of the influence of urban water discharges
M. Campillo-Martinez, T. Benejam, R. Vivien, Centre Ecotoc; S. Pesce, Istea Lyon-Villeurbanne / Microbial ecology of anthropised river systems; L. De Alencastro, École Polytechnique Fédérale de Lausanne / Central Environmental Laboratory; N. Dubois, Eawag; L. Rossi, Hydrique Ingénieurs; S. Höss, Ecossa / Animal Ecology; B.J. Ferrari, Centre Ecotox EAWAGEPFL / Lyon.
To do this, a sampling grid composed of 15 sites was developed in the discharge area of the effluent from the Flon river into the lake. At each point, sediment samples were collected to measure metal concentrations and assess the ecotoxicological quality of sediments in the laboratory using a whole sediment toxicity test with ostracods. At six selected sites in the central transect of this sampling grid, corresponding to the extension of the outlet of the Flon river, a more detailed monitoring program was applied, with measurements of PCBs and PAHs concentrations, of the chemical toxicity tests with chironomids, macrophytes and nematodes, as well as the study of the structure of oligochaete communities and tolerance of microbial communities induced by pollution (PICT) were carried out on. The results obtained showed that contamination induced by urban stormwater discharges, identified mainly as copper, zinc, PCBs and PAHs contamination, was eliminated at a short distance from the outlet, although the long-term exposure to these pollutants did not indicate significant toxicity in this area, the study of in situ communities revealed the presence of pollution-resistant species among oligochaetes and bacteric microorganisms. For the most remote sites, the effects observed in the sediments do not appear to be directly related to the stormwater discharges. The origin and dynamics of the contamination still require further investigations, based in particular on nutrient and hydrodynamic model. Overall, this study paves the way for the development of practical tools for assessing the impacts of urban stormwater discharges in lakes in Switzerland.

WE188
Ecotoxicological profiling of sediments along the River Wurm by Aachen (North-Rhine-Westphalia, Germany)
A. Shulakevich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; Y. Müller, RWTH Aachen University / Institute for Environmental Research; S. Hotz, RWTH Aachen University / Department of Ecosystem Analysis ESA; S. Schiwy, RWTH Aachen University / Department of Ecosystem Analysis; S. Karnatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S. Oster, H. Hollert, RWTH Aachen University / Institute for Environmental Research

River sediments serve as a sink and source for micropollutants. Characterized by their semi-dynamic behaviour, sediments can assimilate contaminants. Naturally occurring events such as storms, currents and flood events, as well as human activities like dredging can cause resuspension of sediments and, thus, pose a threat to aquatic organisms. So far, many investigations have been conducted to assess the biological responses in the water phase of streams being impacted by effluent from waste water treatment plants (WWTPs). However, the impact of WWTPs to sediments is still unknown. The present study was taking place within the DemO2 AC-Project aimed at assessing the ecotoxicological status of the sediment near Aachen. This stream is heavily impacted by anthropogenic activities, such as urbanisation, agriculture, industry, etc. Moreover, the River Wurm receives effluents from various WWTPs within the catchment area. Two of them, the WWTP Aachen Soers and the WWTP Eilendorf, served as investigative objects. Special attention is paid to the WWTP Aachen Soers, which will be upgraded by a full-scale ozonation at the end of 2017. To evaluate a possible impact of the WWTPs on the current ecotoxicalogical status of the stream a comprehensive ecotoxicological profiling of the sediments from 7 sites up- and downstream of the aforementioned WWTPs was performed. The samples were tested both as native and freeze-dried samples in the sediment contact assay with Danio rerio. Sediment extracts (25 g SEQ/ml) were applied for the fish embryo toxicity test with Danio rerio in static and flow-through setups. The results showed estrogenic and mutagenic potential in sediment extracts upstream the tested WWTPs. The embryotoxic potential (enlarged heart, insufficient blood circulation, oedema, etc.) was accounted for the sediment extracts upstream of the WWTP Aachen Soers only. Exposure to native sediments did not lead to any adverse effects in embryos of the zebrafish. However, exposure to freeze dried sediments revealed reduced reactivity of fish embryos. Observed neurological conspicuousness will be verified by further investigations. The described toxicological profiling of sediments will also be completed by chemical analysis. Phase 2 of the DemO2 AC-Project will contain comparative studies in order to evaluate the possible influence to sediment toxicology after implementation of full-scale ozonation.

WE189
Comparing conventional and integrative concepts for sediment classification systems
S. Fartisch, Humburg University of Applied Sciences (HAW); S. Höss, Ecosa / Analytical Ecology; S. Heise, Hamburg University of Applied Sciences / Life Sciences

Environmental regulations and guidelines in Europe for assessing the quality of aquatic sediments and dredged material predominantly demand chemical data, and decision making mostly does not integrate the information from different lines of evidence (1, 2). Ecotoxicological data requirements are often limited, with the final classification of the sample not preserving the information of all applied biotests (3). Improved, holistic characterization of sediments and dredged material is needed, to enable a better risk assessment that conserves the ecological quality, is practical and economically feasible at the same time. This poster will present the concept of a study in the scope of the Interreg project “Sullied Sediments” (http://northsearegion.eu/sullied-sediments/) and will discuss first results. The study aims at comparing and evaluating conventional and alternative, integrative and science-based sediment classification concepts for holistic assessments of sediment quality, such as fuzzy-logic based classification (4, 5). Selected concepts will be applied on the classification of sediments from inland waterways in the North Sea region. A sediment quality triad approach will assess the ecotoxicity, the ecological and chemical quality of the chemistry of sediment samples from this catchment area of the North Sea region with management problems related to polluted sediments. The locations of the sites are in the Port of Hamburg and along the River Elbe in Germany, on the Rivers Hull in the UK and Scheldt in Belgium and in the Netherlands. The applied biotest battery for assessing the ecotoxicological potential of the sediments will cover different trophic levels, different sensitivities and different exposure pathways, considering the toxicity of sediment contact tests, elutriates and extracts. The analysis of the benthic meiofaunal community will assess the ecology of the sediments. The chemical analyses will comprise a broad range of historic contaminants and emerging pollutants, originating from industrial activities, agriculture and pharmaceuticals. This work will be the basis for developing an improved, integrated sediment classification system. References Ahlf et al., 2002. JSS 2: 37–42 Deckere et al., 2011. JSS 11: 504–517 Duff et al., 2003. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) Hollert et al., 2002. Ecotoxicology 11: 311-321 Keiter et al., 2009. JSS 9: 168

WE190
Submarine sewage outfall adversely affects the sediment quality of Santos, Brazil estuary - An acute toxicity study
A. dos Santos, Faculdade de Ciências Farmacêuticas - USP / Departamento de Análises Clínicas e Toxicológicas; M. Artal, University of Sao Paulo - USP / Toxicology and Toxicology analysis; J.A. Vendedini, F.I. Vacheci, University of Campinas / LEAL Laboratory of Aquatic Toxicology (UNICAMP); J. Guillard, INRA, School of Technology, UNICAMP / LAEGL One solution for sewage disposal in several countries is primary treatment followed by chlorination and its discharge in the sea. In Santos city, SP, Brazil, 1 million of cubic meters of urban effluent are discharged into the Santos Bay every day, 4.5 km from the beach. To assess the toxicity of environmental samples it is important to use species that are representative of the ecosystem we want to protect. So, the aim of this work was to evaluate the acute toxicity of water and sediment samples collected in the area under the influence of this discharge using the native marine amphipod Parhyale hawaiensis. Three campaigns were conducted. Acute toxicity tests were performed in water and in fresh and dried sediment as well water and sediment using 96 wells microplates, and the sediment using 12 wells-microplates containing sediment and salt water in 1:4 (w/v). Exposure conditions were 96h, 24±2ºC, 12h/12h light and dark. All water and water extracts samples did not present toxicity. Fresh and dried sediment were toxic ranging from 17 to 100% mortality as well the respective organic extracts. The observed toxicity is probably mainly related to organic contaminants adsorbed to the sediment particles. The sediment of the area seems to be adversely affected by the influence the outfall discharged. Acknowledgements: FAPESP 2015/24758-5 and CNPq 400362/2014-7.

WE191
Swimming in turbid water: impacts of suspended fine sediments on fish physiology
M. Lefranç, S. Amadruit, L. Merle, J. ORourke, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; L. Espinet, INRA; S. Bony, INRA-CNRS / IPE; A. Devaux, INRA-CNRS /UMR LEHNA USC INRA IGH ENTE; J. Guillard, INRA, Université Savoie Mont Blanc / CARTEL Centre alpins sur les réseaux trophiques des écosystèmes limniques; F. Cattaneo, R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems group

Anthropogenic activities lead to increasing sediment deposition in many rivers worldwide which must be managed to preserve industrial activities and population safety. In a current context sediment and contaminant flushing are common actions that release downstream accumulated sediments thus increasing sediment loads which in turn impairs freshwater biodiversity. Reported impacts on fish species vary from mortality, behavioral changes, to physiological and histological impairment depending on SSC and exposure duration. Juveniles of rainbow trout (Oncorhynchus mykiss) and roach (Rutilus rutilus) were exposed in semi-static conditions (0.40, 200 and 1000 mg/L of non-contaminated fine sediments (onica) for 28 days, mimicking dredging operations in terms of duration and environmental concentrations. They were sampled weekly, and mortality, condition index and histological gill lesions were evaluated. Several physiological parameters were also investigated to assess the level of oxidative stress and genotoxicity. Oxidative damages in gills were investigated measuring the level of lipid peroxidation (TBARS) as well as superoxide dismutase activity (SOD) involved in oxygen radical metabolism. The level of primary DNA damage in erythrocytes was measured with the alkaline comet assay. This preliminary work highlight that 28 days of exposure to fine sediments at high concentrations do not induce drastic
mortalities as predicted by models and the scientific literature. Physiological parameters investigated in rainbow trout acted as early signals of biological defects pointing out a high level of genotoxicity measured in erythrocytes in exposed individuals as well as in the control batch; these decreased during the experiment until a basal level pointing out the resilience of fish whereas they were exposed for 28 days to high fine sediment concentrations. Roach exposure to suspended fine sediments did not induce erythrocytic or anoxia-related effects. These results meant that fine sediment exposure did not lead to a physiological stress through the alteration of respiration and osmoregulation homeostasis but suggested that trout experienced undesired past stressful conditions (aquaculture) independent from the sediment exposure. However, we cannot conclude that exposures of juvenile fish to such sediment concentrations would not lead to biological detrimental effects without further considering environmental sediment quality.

**WE192 Assessing the bioavailability of metals in natural sediments by DGT passive sampling and bioaccumulation**

H. Hettinger, SPHERE / SHERE, K. De Schamphelaere, University of Antwerp / Department of Biology SPHERE and ECORE Research Groups; J. Teuchies, E. Amato, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Worldwide, high metal concentrations from recent and historic sediment contamination form a widespread problem and are of major concern for water system management due to their impact on the surrounding water quality and resident biota. Sediment (metal) matrices can be present in a range of physical and physicochemical forms, some of which may be unavailable, non-toxic and therefore not-harmful to organisms so that the interplay between chemical speciation and biological effects can be very site specific and hard to predict. Total sediment concentrations are therefore often found to be poor predictors of the actual risk and a measure of bioavailability should be considered in risk assessment procedures. In this regard however, limited technical information on the bioaccumulation in exposed organisms has been experienced to be highly disruptive, time consuming and limited in comparability as its results are strongly dependent on the analysed organisms themselves. Therefore, an increasing need for less disruptive, more reliable and standardized methods exists. Recently, passive samplers have been tested to estimate bioavailable contaminant fractions as well as the contaminant flux over sediment-water interface. Diffusive Gradient in Thin film samplers (DGTs) have been indicated to provide reliable predictions of metal bioavailability and toxic potential for single (benthic) invertebrate species under (semi-) controlled conditions. The main objective of this study is to further evaluate the use of DGT passive samplers as indicators for the bioavailability of metals for (benthic) ecotoxicological testing and to test the robustness of the results from laboratory studies under field conditions. In an extensive field and laboratory study, which will be performed in April 2018, the impact of a range of contaminated freshwater sediments with known physicochemical characteristics and metal gradients on species performance will be tested. Bioavailable metal fractions will be determined by the use of DGTs and by measuring the metal body burden and metal body content (including inorganic and organic forms) in field biota. For each study site, a suite of test species will be exposed to spiked laboratory bioassays.

**WE193 Ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant - state of a receiving river before implementing an ozonation treatment**

N. Willbrand, RWTW Aachen University; A. Shulakevich, Institute for Environmental Research (RWTW Aachen University) / Institute for Environmental Research; Y. Müller, RWTW Aachen University / Institute for Environmental Research; S. Schiwy, RWTW Aachen University / Department of Ecosystem Analysis; H. Hollert, RWTW Aachen University / Institute for Environmental Research

Since our economic progress continues, the environmental pollution increases. The contamination of the aquatic environment with chemicals is one of the major concerns of our sustainable society. Moreover, over 100 million tons of compounds are applied in industrial processes and consumables every year. A considerable part of it enters waterbodies from diffuse and point sources. [1] Micropolitants originating from e.g. pharmaceuticals and personal care products may cause adverse effects on different biological and ecological levels. A major concern is the fact that these substances are not fully removed during common wastewater treatment and, therefore, end up into surface and groundwater. Furthermore, some micropolitants from wastewater treatment plants (WWTP) additional treatment steps are required. Ozonation has been shown to be an effective method with reasonable costs. Hence, ozone treatment of the entire effluent is implemented in the Aachen-Soers WWTP, Germany, within the DemoO-AC-project. In this context, the actual ecotoxicological state of the recipient water, the River Wurm, and the upstream tributary, the River Haarbach, was evaluated before the implementation of the facility. The River Haarbach receives effluents from the Aachen-Eilendorf WWTP. Therefore, water and sediment samples from various sites upstream and downstream the WWTPs were investigated. This study focuses on the assessment of the sediment samples of the both rivers, since they play an important role in e.g. binding and remobilisation of substances. After the extraction of the sediments via pressurised liquid extraction, cell-based biosassays with reporter cell lines will be conducted to estimate the anti-estrogenic and oxidative stress potential. Following, both native samples and extracts will be tested in the behavioural light/dark transition test with Danio rerio. This test utilizes the fish’s scototaxis (aversion to bright areas and natural preference for the dark) to evaluated effects of neuroactive compounds within these matrices. [1] Schwarzenbach et al. (2006). Science.

**WE194 Dredging sediment quality evaluation: a comparison of an ecotoxicological classification using an weight-of-evidence approach and a “pass to fail” criteria**

V. Piazza, E. Costa, F. Garaventa, CNR ISMAR; D. Sartori, V. Vitiello, D. Pellegrini, ISPIRA Institute for Environmental Protection and Research; I. Lanzoni, Department of Life and Environmental Sciences Polytechnic University of Marche Ancona Italy; F. Regoli, Università Politecnica delle Marche; M. Faimali, CNR ISMAR

Recently a new regulation for the management of dredging sediment has been introduced in Italian legislation (Decree of Italian Ministry of Environment n. 173/2016), establishing criteria and methodological procedures for dredging sediment characterization, their classification and identification of appropriate management options and monitoring. One of main novelties is represented by the Enviromony role assigned by economic trials. To be able to conduct these evaluations, a battery of biosassays that considers the use of three species belonging to different trophic levels has to be applied both to solid phase and liquid phase (pore water or elutriate) of sediment. The results of ecotoxicological analyses are then assessed as a whole at the level of "battery" (not of single bioassay), weighting the biological relevance of the measured effects, the sensitivity of organism, the statistical significance of measured results and their consistency with previous results in terms of reproduction of exposure. Chemical and ecotoxicological data are finally integrated for sediment quality assessment, following the weight of evidence (WOE) criteria, this representing an innovative approach respect to previous regulation, where chemical classification was determined by at least one parameter exceeding the threshold level and ecotoxicological classification was determined by the worst bioassay result of the whole battery. In this work, a comparison between "old" and "new" sediment quality assessment was performed, applying the two classification methods to ecotoxicological data obtained on dredging sediments from different study sites. Results obtained underline the importance of using an integrated and weighted approach (WOE) respect to a “pass to fail” criteria.

**WE195 Toxicity of sediment-bound lufenuron to aquatic arthropods in laboratory biosassays**

T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; D. Belgers, Wageningen Environmental Research Alterra / Environment Risk Assessment Team; M. Boerwinkel, Wageningen University / IBED / Aquatic Environmental Ecology; I. Roessink, Alterra / Environmental Risk Assessment

Lipophytic pesticides are frequently detected in sediments, potentially leading to toxic effects on freshwater benthic organisms. We selected the benzoylurea insecticide lufenuron as one of the benchmark substances to evaluate the prospective environmental effect assessment procedure for sediment-associated pesticides. 10-day and 28-day toxicity estimates from sediment-spiked laboratory biosassays with benthic arthropods belonging to different taxonomic groups are presented. In the 10-day sediment-spiked toxicity tests the LC50 values showed the following order from low to high LC50: Chironomus riparius > Chironomus dilutus > Chironomus thummi > Hyalella azteca > Asellus aquaticus and Sialis lutaria. The Hazardous Concentration to 5% of the tested species (HC5 and 95% confidence limit) derived from these 10d-LC50 values was 2.2 (1.2-5.7) µg/g organic carbon (OC). This HC5 value is approximately a factor of 2 lower than the 10-d LC50 estimate (4.37 ± 0.49 µg/g OC) for the most sensitive standard test species Chironomus riparius. Valid 28-d LC10 values could be derived for 7 benthic arthropods. These 28d-LC10 values showed the following order from low to high LC10: Asellus aquaticus > Chironomus riparius > Chironomus dilutus > Ephemeroidea danica > Hyalella azteca > Gammarus pulex > Sialis lutaria. The HC5 and 95% confidence interval derived from these 28-LC10 values was 0.13 (0.02-1.50) µg/g OC. This HC5 value is approximately a factor of 3 lower than the 28-d LC10 estimate for the most sensitive standard test species Chironomus riparius (0.49 ± 0.49 µg/g OC). These data show that Chironomus riparius is a representative standard test species to assess the potential risks of sediment exposure to the insecticide lufenuron. The HC5 obtained from 28-LC10 values was a factor of 6 lower than the the NOEC for the most sensitive
population (0.79 µg/g OC) in a sediment-spiked microcosm experiment, while the HCs from 10d-LC50's was approximately a factor of 3 higher than this microcosm threshold concentration.

WE196

Application of an undisturbed sampling technique for depth related analysis of nutrients and water in sediments in two EFICOS 219 sediment test systems A. Dorn, Hochschule Niederrein / Department of Chemistry; P. Dalkmann, Bayer AG Crop Science Division; D. Faber, Bayer AG, Crop Science Division / BCS D ETX Ecotoxicology; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety, E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; M. Iager, Hochschule Niederrein / Department of Chemistry Sediment toxicity testing of plant protection products (PPP) is gaining an increasing awareness within the scientific and regulatory community. Currently, PPP concentrations in sediment and pore-water of Chironomid toxicity tests acc. to OECD test guideline (TG) 218/219 are determined as mean over the entire sediment layer of the test system. Hence, a depth-related measurement would contribute to a more accurate assessment of the effective exposure for the predominantly surface sediment dwelling test organism. Therefore, we developed an undisturbed sampling technique and processing enabling the depth-related analysis of active substances in pore-water and adsorbed to sediment particles. After removing the water phase, plastic tubes were stung into the ca. 15 mm-thick sediment layer, which was subsequently frozen by liquid nitrogen. By the use of a special developed cutting device, the sediment cores were cut into three slices providing a thickness of ca. 5 mm. Each sediment slice was centrifuged to isolate the pore-water. A sequential extraction was performed to extract the sediment adsorbed residues. After combining the sediment extracts, pore-waters and sediment extracts were analysed by LC-MS/MS. To validate this newly developed sampling technique, a Chironomus toxicity study acc. to OECD TG 219 was conducted. Two model compounds (logPow < 1) and B (logPow > 2) were applied as mixture at nominal concentrations of 2 µg/L. To investigate the spatiotemporal behaviour of the compounds, test systems were incubated and processed 3, 7, 14, 21, and 28 days after treatment (DAT). The concentration of the applied compounds increased in the overlying water during the experimental duration. Both compounds were primarily found adsorbed on the sediment phase (ca. 40-50 % of applied compounds). Approx. 0.2 - 1 % of the applied compounds were recovered in the pore-water at the same time. The analytical results of pore-water and sediment extracts show that the highest amounts of both compounds were in the upper layer of the sediment during the experimental duration. Nevertheless, the results indicate the concentrations differences between the top layer and the layers below will be equalized in the course of time. These first results indicate that the newly developed sampling technique can provide a substantial contribution to a more realistic determination of exposure concentrations in chronic water-sediment toxicity tests, leading to an improved sediment risk assessment.

WE197

SETAC Sediment Interest Group P.K. Sibley, University of Guelph / School of Environmental Sciences Improving the environmental risk assessment of the aquaculture 'Blue Revolution' (P)

WE198

Global overview of aquaculture production with a focus on the development and current status of the activity in Portugal C.V. Rocha, MARE-FCUL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University Aquaculture activity experienced true global development firstly at the beginning of the 1900’s and then around 1970’s, as a result of the awareness of the negative impacts that years of intensive fisheries brought to wild stocks’ status, which contributed to the assessment of the effective exposure for the predominantly surface sediment dwelling test organism. Therefore, we developed an undisturbed sampling technique and processing enabling the depth-related analysis of active substances in pore-water and adsorbed to sediment particles. After removing the water phase, plastic tubes were stung into the ca. 15 mm-thick sediment layer, which was subsequently frozen by liquid nitrogen. By the use of a special developed cutting device, the sediment cores were cut into three slices providing a thickness of ca. 5 mm. Each sediment slice was centrifuged to isolate the pore-water. A sequential extraction was performed to extract the sediment adsorbed residues. After combining the sediment extracts, pore-waters and sediment extracts were analysed by LC-MS/MS. To validate this newly developed sampling technique, a Chironomus toxicity study acc. to OECD TG 219 was conducted. Two model compounds (logPow < 1) and B (logPow > 2) were applied as mixture at nominal concentrations of 2 µg/L. To investigate the spatiotemporal behaviour of the compounds, test systems were incubated and processed 3, 7, 14, 21, and 28 days after treatment (DAT). The concentration of the applied compounds increased in the overlying water during the experimental duration. Both compounds were primarily found adsorbed on the sediment phase (ca. 40-50 % of applied compounds). Approx. 0.2 - 1 % of the applied compounds were recovered in the pore-water at the same time. The analytical results of pore-water and sediment extracts show that the highest amounts of both compounds were in the upper layer of the sediment during the experimental duration. Nevertheless, the results indicate the concentrations differences between the top layer and the layers below will be equalized in the course of time. These first results indicate that the newly developed sampling technique can provide a substantial contribution to a more realistic determination of exposure concentrations in chronic water-sediment toxicity tests, leading to an improved sediment risk assessment.

WE199

Characterization of the ontogenetic variation and nutritional content of Gilthead seabream and European seabass reared in two Portuguese estuaries C.V. Rocha, MARE-FCUL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; C. Nunes, ICCO & QOPNA, Aveiro University; M.A. Coimbra, QOPNA, Universidade de Aveiro; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University The nutritional value and potential ontogenetic variations of cultured fish was assessed for the European seabass and the Gilthead seabream specimens reared in semi-intensive systems in two southern European estuarine systems, the Sado and Mondego estuaries in Portugal. Quantification of total protein, carbohydrate and fatty acid profiles were determined to assess differences between the organoleptic composition of organisms of the same species reared in four different aquacultures (two semi-intensive in each estuary). No significant differences were found among groups of both species regarding protein content. A significant influence of the rearing site was found for the European seabass regarding saturated (SFA), monounsaturated (MUFA) and highly unsaturated fatty acid (HUFAs) contents, either between estuaries and within each estuary. In the Gilthead seabream, SFA, MUFA, polyunsaturated fatty acid and HUFAs contents were also influenced by the rearing site. Eicosapentaenoic acid, docosahexaenoic acid, arachidonic acid and linoleic acid content in adults specimens were dependent on the fish rearing site. In general, seabass and seabream fatty acid content was higher in organisms reared in the Sado estuary, when compared to the individuals reared in the Mondego estuary. Carbohydrate analysis showed a significant influence of the rearing site on free sugar and polysaccharide content in fish of both species. Differences in fatty acid and carbohydrates content among juvenile and adult stages were found for all groups studied. The present work supported the existing evidence that semi-intensive rearing systems are subjected to the variability of extrinsic factors, namely the different anthropogenic pressures these systems are subjected to, causing fluctuations in water quality and composition, which may influence the fish performance and product quality. From the consumer’s perspective, such differences may come as a disadvantage, as it is expected for a product to provide equal nutritional properties and benefits regardless its origin, especially within the same country. From the farmer’s perspective, such vulnerability requires constant monitoring of the extrinsic parameters within the facilities, in order to avoid great losses of the product. Further studies should be conducted to define the parameters that should be regulated and monitored in semi-intensive systems to obtain the best product with the highest quality.

WE200

Effects of aquaculture antibiotics on marine biofilms and on the amphipod Gammarus aequicostatus B. Gonzalez-Gaya, IMDEA Water (G84912732) / Environmental Chemistry; N. García Bueno, I. Gomez, J. Martinez, C. Marin, B. Martinez-Lopez, A. Marin, University of Murcia / Ecology and Hydrology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology Intensive aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics may cause adverse effects on potentially sensitive organisms such as non-target microorganisms, primary producers or benthic invertebrates. The objective of this study was to evaluate the potential side effects of two antibiotics used in aquaculture (oxytetracycline and flunixinme) on the community composition of marine biofilms exposed to these substances and on the community composition of marine Gammarus aequicostatus. Marine biofilms were exposed to 3 different antibiotics: fluoroquinolones (foxacin and enrofloxacin), oxytetracycline and flunixinme for 3 weeks. Marine biofilms were exposed to 1, 10, 100 and 1000 µg/L of oxytetracycline and flunixinme for one week under laboratory conditions. Subsequently, the exposed biofilms were used to infect G. aequicostatus organisms for 2 weeks. The G. aequicostatus aquaria set ups were run with two treatments in parallel: (1) with input of antibiotics only from the biofilm and (2) with antibiotics administered via biofilm and also spiked into the water. This was done to test different bioaccumulation routes (i.e., ingestion only and water exposure combined with ingestion). All the treatments for biofilm and crustaceans test were run in triplicate. Preliminary results show a marginally enhanced biomass growth of the biofilm with increasing dose of both antibiotics,
being this slightly higher in the oxytetracycline test. No correlation was found between antibiotics concentration and elemental composition (analyzed carbon, sulfur and total phosphorus), although nitrogen content was slightly higher in the medicated biofilm. Biofilm arborescence (vertical structures observed through optical microscopy) coverage was statistically different among treatments, showing a non-linear response. Experimental results show that low exposure concentrations contributed to a higher arborosity up to 180 µg/L, while the highest tested concentrations contributed to a decrease of the biofilm arborosity. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistome), diatoms identification, and photosynthetic activity assessment. Regarding the G. aeruicada test, the experimental results do not show an effect over their size or weight by the feeding on antibiotic exposed biofilms. Reproduction and survival were not compromised either. Also bioaccumulation will be analyzed to determine the relevance of each of the evaluated antibiotic exposure routes.

WE201
Shifts in the diatom assemblage structure and biological traits of marine biofilms exposed to antibiotics used in aquaculture.

N. García Bueno, C. Marin, A. Marin, University of Murcia / Ecology and Hydrology; B. Gonzalez-Gaya, IMDEA Water (G84912732) / Environmental Chemistry; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

The use of antibiotics, anti-fouling paints, and fish food are all potential sources of chemical contaminants from commercial aquaculture operations such as fish farms. Importantly, the current framework for the treatment of which requires the intensive use of antibiotics. The objective of this study was to evaluate the potential side effect of two antibiotics used in aquaculture (oxytetracycline and flumequine) on the diatom assemblage structure and biological traits of marine biofilms exposed to these substances. Biofilms were grown during two weeks under natural conditions on glass slides. Two experiments were carried out under laboratory conditions. The first experiment was carried out in the presence of other marine biofilms dominated by a reduced growth forms (biological traits of marine biofilms exposed to antibiotics used in aquaculture)

WE202
Assessing the oxidizing effects of hydrogen peroxide using flow cytometry as a high throughput method

A. Almeida, Norwegian Institute for Water Research NIVA; A. Lillicip, NIVA / Ecotoxicology and Risk Assessment

Hydrogen peroxide ($H_2O_2$) is widely used in commercial, industrial, medical, environmental and hygiene applications. It is applied in aquaculture for controlling biological problems such as salmon lice. $H_2O_2$ produces highly oxidizing radicals that can cause paralysis, peroxidation in organelle membranes and inhibition of enzymes that replicate DNA in biological organisms. The release of $H_2O_2$ as an effluent into the marine environment is therefore a cause for concern particularly to primary producers such as algae. With the use of flow cytometry, single cells of algae with different features and physiological states, can be examined based on the expression of fluorescence intensity. The potential of flow cytometry enables fluorometric determinations of several parameters such as the ability of reactive oxygen species (ROS) to oxidize non-fluorescent probes to fluorescent products. In the present study, the effects of $H_2O_2$ on Skeletonema pseudocostatum were analysed. The method provided a rapid assessment of several endpoints in the same exposed samples. Effects on growth, photopigments and the detection of intracellular ROS production, using 3 molecular probes, were measured within 72 hours. $H_2O_2$ was used for determining the oxidative burst, DHR 123 for mitochondrial oxidation, and BODIPY $581/591$ to determine lipid peroxidation (LPO). Exposure concentrations were selected to cover the overall concentration response curve and a short-term exposure was also made to discern initial high reactivity of $H_2O_2$. Chemical analyses were performed to verify the stability of the concentrations during the exposure duration. The short-term exposures demonstrated rapid high toxicity of $H_2O_2$ to algae, where ROS production and the response to the photopigments were the observed endpoints. Over the 72 h, the response of the algae at the different test concentration clearly differed. The accessory photopigments actively responded when the main natural pigments declined. The ROS protective system seemed to be active at medium concentrations, whereas at higher concentrations damage on membranes liquids and mitochondria possibly instigated cell failure. This high throughput approach demonstrated a great potential to study the oxidizing effects of hazardous compounds in algae. While growth inhibition allowed to discriminate the overall toxicity, the high throughput methods, using flow cytometry, helped to screen and characterize the Mode of Action of $H_2O_2$.

WE203
An updated version of the SEPA BathAuto tool for assessing anti-parasitic chemical treatments in marine fish farms

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Marine fish farms operators in Scotland wishing to use anti-parasitic chemicals as bath treatments must first obtain a discharge licence from the Scottish Environment Protection Agency (SEPA). Discharge licences are granted by SEPA on a per-site basis, with the quantity of chemical that can be released from a particular fish farm determined by computer modelling. This computer modelling considers the location and composition of the fish farm, along with hydrographic data measured at the site and the toxicity and environmental fate of the chemicals concerned. Discharge quantities are typically calculated for three anti-parasitic chemicals: azamethiphos, cypermethrin and deltamethrin. Of these, cypermethrin and deltamethrin are rapidly removed from the aqueous phase via binding to particles, and are therefore assessed using SEPA’s short-term model, which calculates projected concentrations in the chemical patch up to 6 hours after its release from the fish farm. Azamethiphos, however, remains in the aqueous phase for several days until it is broken down, and is therefore also assessed using a longer-term model, originally developed by Gibillardi and Turrell (1999; MLA Report No 297) and recently extended by Carnall, Ericher and Hughes (2017; poster presentation at SETAC Europe 2017). The SEPA tool BathAuto integrates both the short and long-term models, iteratively performing calculations of chemical concentrations in the water in order to arrive at safe discharge limits for a fish farm. In this poster we present an updated version of BathAuto in which the longer-term model is now fully integrated into the BathAuto tool. The standalone executable required previously for the long term calculations (opendisp.exe) is no longer used, improving the compatibility of the revised tool with modern operating systems. While the standard modelling parameters required by SEPA for discharge licensing in Scotland are included as default, BathAuto could readily be modified to include alternative parameters or chemical data, potentially making this tool available for use far beyond the limits of the anti-parasitic chemicals currently assessed. The revised version of BathAuto also offers improved graphical outputs, and the ability to calculate several options for compliant cage treatment regimes.

WE204
State-of-the-art on the use of models for the ERA of chemicals used in aquaculture


As aquaculture is expanding and becoming a more diverse industry in terms of species and production systems, there is an increasing demand to generate improved modelling tools to assess its environmental impacts. Although important developments have been made in disease prevention and treatment, the use of veterinary medicines and other potentially toxic substances (e.g. antifoulants, molluscicides, anti-parasitic chemicals) has increased. This study presents an overview on the use veterinary medicines and other potentially toxic substances used in EU aquaculture, and the environmental standards and regulatory procedures available for their Ecological Risk Assessment (ERA). Furthermore, it describes the state-of-the-art on the development of models capable of assessing the fate, dispersal, exposure, ecological effects and associated ecological and environmental risks of veterinary medicines applied in aquaculture production. This study shows that a varied range of models has been developed during the last 30 years. Their effective implementation in regulatory ERA is, however, somewhat limited in many state members. Some recommendations are provided as to improve the chemical exposure assessments and the ecological realism of the modelling outcomes, paying a special attention to the protection goals set for the regulatory ERA of veterinary medicines.

WE205
Effects of an aquaculture parasiticide (difluenzuron) on non-target shrimp

373
 SETAC Europe 28th Annual Meeting Abstract Book
populations: from lab experiments to population-level endpoints

J. Mog, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; D. Hjerrym, NIVA Norwegian Institute for Water Research; E. Ravagnan, R. Behemann, International Research Institute of Stavanger

The continued growth of marine aquaculture production has presented the industry with environmental and production concerns, of which the ectoparasitic salmon lice (Lepeophtheirus salmonis) has gradually become a major problem. A commonly used parasiticide against this crustacean is diflubenzuron (DFB), which acts as a chitin synthesis inhibitor and thereby interfere with the molting stages during sea lice development. However, DFB from the fish feed may also affect non-target crustaceans such as the Northern shrimp (Pandalus borealis), which is an economically and ecologically important species in Norwegian fjords. Laboratory experiments have demonstrated that shrimp exposed to DFB through fish feed have reduced survival (ca. 60%) compared to control, in both the larval and the adult stages. Moreover, the effects of DFB exposure is more severe under future climate conditions (higher temperature). The aim of this study is to make the information on these mechanistic effects more relevant for risk assessment at the population level. We have developed an age-structured population model representing a Northern shrimp population located in a hypothetical Norwegian fjord containing a fish farm, under both ambient and future climates. Our model is based on thorough knowledge of shrimp biology and clear results on toxicological effects from the laboratory experiments. Nevertheless, extrapolating the individual-level effects to the population level poses several challenges. Relevant information on shrimp populations in fjords is sparse (such as abundances, survival and reproductive rates, and their risk-dependent processes). The degree of exposure to potential of DFB at different distances from aquaculture farms is also uncertain. We have therefore developed a model to explore scenarios representing different medicine application schemes and different degrees of exposure for the shrimp populations. The purpose of the model is to predict effects of DFB exposure on population-level endpoints such as long-term abundance and age structure, and to assess the risk of population decline below threshold abundances.

WE206 Contamination and bioaccumulation of heavy metals in the wild and marine farmed milkfish (Chanos chanos) and mullet (Mugil cephalus) and associated health risk along the coasts of Tanzania

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Concentration of heavy metals Cu, Pb, Fe, Zn, Co, Cr, Cd, Ni, Al and As were analysed in the muscles and livers of farmed and wild milkfish and mullets from Tanzanian coast. Fish samples were collected from January 2016 to April 2016 and analysed for heavy metals by using Atomic Absorption Spectrophotometer while hazardous quotient (HQ) and Risk Quotient (RQ) were calculated. Hazard Quotient (HQ) disregard to fish species and in order of decreasing dominance, the overall range of concentrations in (mg/kg ww) of heavy metals were; Fe (> LOD-11.96), Pb (0.54-1.96), Zn (< LOD-2.81), Cu (< LOD-2.31), Ni (0.015-0.098), Co (< LOD-0.086), Cd (< LOD-0.024, Cr (< LOD-0.079) and Fe (< LOD-147.9), Pb (0.92-47.37), Zn (< LOD-15.08), Cu (< LOD-12.24), Ni (0.027-0.994), Co (< LOD-0.013), Cr (0.013-0.031) in muscles and livers respectively. Al and As were not detected above limit of detection in any of the analysed samples. Metals showed different affinity to muscles and livers of milkfish and mullets whereas Co and Cd had higher levels in the muscles than in the livers, Cu, Pb, Fe, Zn and Ni were higher in livers than in the muscles of milkfish. In Mullet, Fe, Co, Cr, and Cd levels were higher in the muscles than in the livers, Cu, Pb, Zn, and Ni were levels were higher in the livers than in the muscles. The concentration of Pb in the muscles of all analysed fish were above the Maximum Recommended Levels (MRLs) by FAO/WHO, EU and USFDA for human consumption. Other metals were below the MRLs. The THQ for all analysed metals were below 1 indicating that the metals are likely to present insignificant health risk to fish consumers. However, based on MRLs recommended for human consumption, the metals may pose health risk to human as fish consumer and threatens fish biodiversity. Therefore, this research calls for regular monitoring of heavy metals in fish for consumption and strengthening pollution control measures.

WE207 Potent Toxic and Phototoxic Effects of Benzo[b]cyclobenzazepine on Crayfish

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Benzo[b]cyclobenzazepine is the active ingredient in the herbicide, BUTTE®. In 2001, various formulations using benzo[b]cyclobenzazepine as the active ingredient were approved for use in Japan. It was approved for use in the United States and registered in California as of 2016, and was first applied to rice fields in the 2017 growing season. Benzo[b]cyclobenz azepine is a psychostimulant that acts as a HPPD inhibitor, leading to the bleaching of weed species to ultimately kill them. With an increase in herbicide-resistant weed species, new formulations of herbicides to combat this in rice fields is advantageous. California is the second largest producer of rice in the United States, with Louisiana as the third largest producer; Arkansas leads the country in rice production. Unlike California, Louisiana has a unique system where rice fields not only grow rice but also grow crayfish for harvest and consumption. The bleached rice fields are prime habitat for crayfish to reside; therefore, crayfish are at risk for exposure to pesticides used in the rice production. Benzo[b]cyclobenzazepine readily hydrolyzes to benzocyclobenzazepine hydrolystate, and therefore it likely undergoes photolysis as well. The potential for toxic or phototoxic impacts of benzocyclobenzazepine or its intermediate degradation products to crayfish is important to know for the possible future registration of BUTTE® in Louisiana.

WE208 Effects of the isoflavones, genistein and daidzein, on Acetylcholinesterase from head of Solea Senegalensis.

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The aquaculture is an important economic activity in our area, and one of the main concerns of this sector is fish feed. One of the proposed alternatives to fish meal in feeds are vegetable proteins, and among plant protein sources, soybean is noteworthy. This plant has flavonoidicoccluding the isoflavones daidzein and genistein. S. senegalensis is a flatfish of high commercial importance both in aquaculture and fisheries in Southern Europe with a wide geographic distribution and availability, and its biological cycle is well known. The aim of this work was to study the effects of the isoflavones, genistein and daidzein, on juveniles (weight 1.23 ± 0.41 g) of S. senegalensis. The 96-h toxicity tests were conducted with continuous aeration and water renewal every 24 hours, at a temperature of 19-20°C and a pH of 7.6-8.5. After 96 h, mortality was observed. Feed and fish head acetylcholinesterase (ACHE) was measured with acetylthiocholine as a substrate after inhibiting butyrylcholinesterase with iso-OMPA. No mortality was observed within the period of the test when the fishes were exposed up to 20 mg/l genistein and 10 mg/l daidzein. Besides, head ACHE activity was not altered in fish exposed to genistein, but daidzein was found to enhance ACHE activity at a concentration equal or higher than 2.5 mg/l after 4 days of exposure. Acknowledgements: Authors are grateful to the Laboratory of Marine Culture at University of Cádiz for providing the experimental fish used in this study. This work was supported by National R&DI Plan Ministry of Economy, Industry and Competitiveness (Project: AGL2014-52906-R) and in part by the Andalusian Plan for Research, Development and Innovation (PAIDI group: RNM-345).

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins (P)

WE209 Comparison between results of LumiMARA and Microtox tests

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In a regulatory context of ever increasing environmental responsibility (OSPAR convention, BREF CWW), there is a need to have biomonitoring tools to evaluate waste water quality. To date, and for several decades, the standard toxicity testing tool used for rapid analysis of waste water has been Microtox®. However, recently a new tool has become available: LumiMARA®, an acute ecotoxicity bioassay which measures the inhibition of luminescence on bacteria in a similar way to Microtox® but with a different design. A dark juveniles were exposed at five nominal concentrations of genistein (range 1.25-20 mg/l) and daidzein (range 0.625-10 mg/l), plus an untreated control and a solvent control (DMSO). Mortality was recorded and fish head acetylcholinesterase (ACHE) was measured with acetylthiocholine as a substrate after inhibiting butyrylcholinesterase with iso-OMPA. No mortality was observed within the period of the test when the fishes were exposed up to 20 mg/l genistein and 10 mg/l daidzein. Besides, head ACHE activity was not altered in fish exposed to genistein, but daidzein was found to enhance ACHE activity at a concentration equal or higher than 2.5 mg/l after 4 days of exposure. Acknowledgements: Authors are grateful to the Laboratory of Marine Culture at University of Cádiz for providing the experimental fish used in this study. This work was supported by National R&DI Plan Ministry of Economy, Industry and Competitiveness (Project: AGL2014-52906-R) and in part by the Andalusian Plan for Research, Development and Innovation (PAIDI group: RNM-345).

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins (P)
in a freshwater environment may be overestimating toxicity of effluents to the freshwater compartment.

**WE210** Bioluminescent assays as tools for studying antioxidant activity and toxicity of bioactive compounds

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This study promotes application of the bacteria-based and enzyme-based bioluminescent assays to evaluate the antioxidant activity of bioactive compounds in oxidizers solutions. Artificial and natural carbon nanostructures – fullerene denoted C60 20 (40°? , 5.3°/s), C60 20C70 (7°/s), and humic substances (HS) are used here as bioactive compounds. Fullerenols are polyhydroxylated water-soluble derivatives of fullerenes, HS are products of natural transformation of organic matter in soil. Bioluminescent assays allow studying toxicity and antioxidant properties of substances. We studied the effect of organic (1,4-benzoquinONE) and inorganic (K2[Fe(CN)6]) oxidizers on bioluminescent tests. We found the effect of alkaline concentrations (EC50) of these oxidizers decreasing bioluminescence intensity by 50%. The EC50 values of 1,4-benzoquinone were 2.510’M and 10’M for bacterial and enzymatic assays, respectively, while the EC50 values of K2[Fe(CN)6] - 4’10’M and 2’10’M. Also we studied the influence of bioactive compounds on the assays. They suppressed bioluminescence of the bacterial and enzymatic systems at concentrations >10’g/L and >0.5’g/L, respectively. Detoxification coefficients can be calculated to characterize changes in toxicity under the action of bioactive compounds. The values of coefficients >1 and So, the bacteria- and enzyme-based assays showed similar peculiarities of detoxification of oxidizer solutions by bioactive compounds. Results show, that low concentrations of bioactive compounds were active. Our work demonstrates a high potential of the bioluminescent assay systems, bacterial and enzymatic, to characterize and compare antioxidant activity of physiologically active compounds.

**WE211** Effect of low-dose gamma-radiation on luminous marine bacteria

Photobacterium Phosphorum

A.S. Petrova, Krasnoyarsk State Agrarian University / Institute of Agrotechnological Technologies; D.V. Dementyev, Institute of Biophysics SB RAS / Radiobiology Lab; N. Kudryasheva, Institute of Biophysics SB RAS

The study addresses biological effects of low-dose gamma-radiation. Radioactive 137Cs-containing particles were used as model sources of gamma-radiation. Luminous marine bacterium Photobacterium phosphoreum was used as a biosensor, to study the bioluminescent parameters with the bioluminescence intensity as the physiological parameter tested. To investigate the sensitivity of the bacteria to the low-dose gamma-radiation exposure (≥250 mGy), the irradiation conditions were varied as follows: bioluminescence intensity was measured at 5, 10, and 20°? for 175, 100, and 47 h, respectively, at different dose rates (up to 4100 mGy/h). There was no noticeable effect of gamma-radiation below 20°?, while the 20°? exposure revealed adequate bioluminescence inhibition. The 20°? results of gamma-radiation exposure were compared to those for low-dose alpha- and beta-radiation exposures studied previously under comparable experimental conditions. In contrast to ionizing radiation of alpha and beta types, gamma-emission did not initiate bacterial bioluminescence activation (adaptive response). As with alpha- and beta-radiation, gamma-radiation exposure did not demonstrate monotonic dose-effect dependencies. The bioluminescence inhibition efficiency was found to be related to the exposure time, while no dose rate dependence was found. The sequence analysis of 16S ribosomal RNA gene did not reveal a mutagenic effect of low-dose gamma radiation. The exposure time that caused 50% bioluminescence inhibition was suggested as a test parameter for radiotoxicity evaluation under conditions of chronic low-dose gamma irradiation.

**WE212** Bioluminescent Assay for Toxicological Assessment of Nanomaterials

E. Esimbekova, Institute of Biophysics SB RAS; E. Nemtsova, Siberian Federal University / Institute of Biophysics and Biotechnology; Y. Kratasyuk, Siberian Federal University / Biophysical

Due to the increasing scale of production and usage of a vast number of new materials in industrial and economic activities, society is faced with problems associated with a lack of materials safety assessment regarding humans, ecosystems and the biosphere as a whole. Nowadays, numerous toxicological investigations using living organisms, cell lines, etc. are carried out in laboratories in order to assess the potential risks of using these materials and their biological effects on human health and the environment. A rapid bioluminescent enzyme inhibition-based assay was applied to predict the potential toxicity of carbon nanomaterials (CNTs) presented by single- and multi-walled nanotubes (SWCNT and MWCNT) and aerogelous solutions of hydrated fullerene C60 (C60HyFn).

This assay specifically detects the influence of substances on parameters of the soluble or immobilised coupled enzyme system of luminescent bacteria: NADP+/FMN-oxido-reductase + luciferase (Red + Luc). A protocol based on the optical properties of CNT for correcting the results of the bioluminescent assay was developed. If the concentration of a nanomaterial solution was greater than 0.1 in the range of 400–600 nm, the light emission intensity was multiplied by the correction factors. It was shown that the inhibitory activity of CNT on Red + Luc decreased in the following order: MWCNT > SWCNT > C60HyFn. The soluble enzyme system Red + Luc had high sensitivity to MWCNT and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L, respectively. The immobilised enzyme system was less sensitive to C60HyFn than its soluble form, with an IC50 equal to 1.4 mg/L. According to EC Directive 93/67/EEC for aquatic organisms, chemicals are classified by their degree of toxicity based on EC50 values. We hypothesised that this classification was correlated with IC50 values and revealed that MWCNT and SWCNT samples might be characterised as extremely toxic and very toxic, respectively. Due to its technical simplicity, rapid response time and high sensitivity, this bioluminescence method has the potential to be developed as a general enzyme inhibition-based assay for a wide variety of nanomaterials. This study was supported by the Russian Science Foundation (project no. 16-14-10115).
as an indicator of the degree of the depth of dormancy. FTC was measured with the needles’ segments using fluorometer Junior-PAM (Walz, Germany). The needles were linearly heated from 25 to 70°C at a rate of 2°C/min using a computer-controlled heating device. In climate conditions of Southern Siberia, disturbance of winter dormancy under air pollution stress represents a major threat to the health status of Pinus sylvestris and Picea obovata. Our data demonstrate that regardless the age of needle and the depth of winter dormancy of both the species clearly correlated with severe pollution levels, and the trees growing in industrial areas were easier to release from dormancy and to be affected by late winter or spring frost. In urban environments the risk of frost injuries is even higher due to early spring warm spells associated with heat island effect. Scots pine is less susceptible to air pollution and temperature fluctuations than Siberian spruce, and therefore represents a better choice for urban forestry projects.

WE215
Luminescent microscopy in the bioindication of the Baikal pollution with oil products and polycromatic hydrocarbon
M.N. Salkisnov, A.E. Balayana, Iktusk State University / Research Institute of Biology of Iktusk State University; O.A. Barkhatova, Iktusk State University / Faculty of Geography; A.D. Stomin, Iktusk State University / Research Institute of Biology of Iktusk State University

Against the backdrop of the growing diversity of toxic substances that degrade the natural environment, the creation of new analytical systems for assessing the state of the environment is of paramount importance. Among such systems in a luminescent microscope. It has been experimentally revealed that the many pollutants of water bodies, it is necessary to isolate oil products and polycromatic compounds (PAHs), the flow of which in the valley is constantly increasing. On Lake Baikal, this is due to the development of tourism, the increase in the number of passenger ships and tourist bases, often not equipped with treatment facilities. The necessary system for monitoring the quality of the aquatic environment, including methods for bioindication, not only on generally accepted test facilities, but also on representative hydrobiologicals for this reservoir. Crustaceans of the order Copepoda, which have well-expressed fatty inclusions in the form of drops, there are several hundred species. Euphausia bicaudalis Sars (Copepoda, Crustacea) - endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. E. bicaudalis accounts for up to 70% of the total biomass of zooplankton. Crustaceans Copepoda, having fat inclusions, accumulate in them oil products. This can, in particular, be observed by the blue-violet glow in a luminescent microscope. The accumulation of diesel fuel by fatty inclusions of Copepoda crustaceans and the high sensitivity of luminescence to the presence of possible trace amounts of this pollutant in the water under investigation. It is noted that in the presence of unicellular algae that are absorbed by the crustaceans, this process is activated and the accumulation time of oil products and PAHs decreases. Another representative of the Copepoda Cyclops Colensis also has chaotically scattered fatty inclusions in which the accumulation of oil products can be seen in a luminescent microscope. It has been experimentally revealed that if E. bicaudalis with oil products or PAHs accumulated in fatty inclusions is added to pure water to C. Colensis, then the staining of fat inclusions also occurs in the latter, that is, this process is transmitted along the trophic chain. Based on these experiments, a method of bioindication on the accumulation of oil products and PAHs in 7 copepoda crustaceans in fat droplets was proposed.

WE216
The correlation between fluorescent properties of water extract from soil and its effect on bioluminescent enzymatic bioassay
E. Nemtseva, O. Chmurina, Iktusk State University / Research Institute of Biology of Iktusk State University; O.A. Barkhatova, Iktusk State University / Faculty of Geography; A.D. Stomin, Iktusk State University / Research Institute of Biology of Iktusk State University

The work is devoted to the development of the bioluminescent enzymatic bioassay of the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of their contamination was under consideration. The new bioassay method assessing the luminescent characteristics of the various soil samples and the results of their bioluminescent bioassay as well as their physico-chemical characteristics. Water extracts from 56 soils (medium and heavy loams, with humus content 1.2-11.3% and detected arsenic 0.088-8.75 µM/L) were studied and compared in their enzymatic activity on the bioluminescent kinetics change under low-dose radiation exposure with alpha-emitting (241Am) and beta-emitting (32P) radionuclides as ions of ionizing radiation. Bioassay kinetics of Photobacterium phosphoreum in solutions of 241Am(N03), 7 kBq/L and tritiated water, 100 MBq/L were recorded. The 16S ribosomal RNA gene was amplified and compared in bacteria exposed to 241Am or HTO and control bacterial suspension not exposed to radiation. The response of bioluminescence reaction to exposures of bacteria to low-dose alpha, beta and gamma radiation has been examined in previous research. The purpose of the current study was to determine whether bacterial genetic alteration is related to bioluminescence kinetics change under low-dose exposure with alpha-emitting (241Am) and beta-emitting (32P) radionuclides as ions of ionizing radiation. Bioassay kinetics of Photobacterium phosphoreum in solutions of 241Am(N03), 7 kBq/L and tritiated water, 100 MBq/L were recorded. The 16S ribosomal RNA gene was amplified and compared in bacteria exposed to 241Am or HTO and control bacterial suspension not exposed to radiation. The response of bioluminescence reaction to exposures of bacteria to low-dose alpha, beta and gamma radiation has been examined in previous research. 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LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (P)

WE219
Meet the Framework Regulation and Supply Chain secondary standards in wheat cultivation for sustainable pasta production. An example of broadleaf weed control: halauxifen-methyl (Arylex™ active)

C. Vaj, S. Cavana, Dow AgroSciences Italia srl; A. Haley, Dow AgroSciences Ltd; W. Jones, DuPont

The need and the awareness of sustainable food production has increased in recent years, driven by the growing awareness of global population increase and its burden on the limited agricultural land available to sustain the required food production. This is being reflected in the choices made at all the steps of food production from field to table. The sustainable production of pasta starts by optimising agricultural practices, which includes the key component of Plant Protection Products (PPP) applied to wheat crops. The development of new Plant Protection Products in Europe is governed by the strictest regulatory framework in the world: Regulation (EC) 1107/2009 concerning the placing of plant protection products on the EU market; Directive 2009/128/EC on Sustainable Use of pesticides and its national implementations (National Action Plans), and Regulation (EC) 396/2005 concerning the Maximum Residue Levels of plant protection products allowed in food. In addition, the Secondary standards coming from Food Processors and Retailers regarding chemical residues in food place increasing standards which have to be considered. The Plant Protection Industry is increasing its focus on sustainable food production not only for complying with the evolving Regulations, but also for helping the farmer to meet the Food Supply Chain needs. A good example of this new emphasis is brought by an innovative axenic herbicide, halauxifen-methyl (Arylex™ active), for the control of broadleaf weeds in spring and winter soft and durum wheat. This highly efficacious herbicide requires low use rates and its inherent properties (rapid degradation in the soil and plant) mean a low environmental and human health impact. Utilising halauxifen-methyl according to its label offers wheat growers a key tool for optimizing production, while producing a commodity with no detectable residues in the grain, in the processed product (flour, bread, wheat germ, malt), and in pasta. Results will be presented and discussed. Therefore, the properties of halauxifen-methyl are fully aligned with increasingly strict environmental requirements from regulatory authorities and the Food Chain Secondary standards. TM Trademark of Dow AgroSciences

WE220
Crable to grave Life Cycle Assessment of Traditional and Vegetative roofs

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The aims of this study are to (1) assess the environmental performance of an extensive green roof (EGR) mock-up installed on the rooftop of the Chemical Engineering Department at the University of Balamand, in the region of El Kurah, North Lebanon (34°51′N, 35°0′E) from the raw material phase until the end-of-life phases; through a cradle to grave Life Cycle Assessment (LCA) study; and (2) compare the environmental impacts of an EGR mock-up to a traditional gravel ballasted rooftop (TBR) mock-up. In this research, the Life Cycle Inventory was modelled using the SimaPro 8.3.0 software and the EcoInvent database, and the IMPACT 2002+ methodology was selected as the Life Cycle Impact Assessment method. Vegetative roofs seem like a possible solution for the environmental issues in Lebanon since this small Mediterranean country lacks a clear sustainability plan as well as an infrastructure update and only 13.4% of the total surface area (10,452km²) are forested area. Vegetative roofs embellish the unused roof surface available in most urban areas, increase the roof lifetime, reduce the need for a heating/cooling system as a result the building energy consumption is decreased, etc. Vegetative roofs capture a fraction of the rainfall water through their growing material and the vegetation could reduce airborne pollutants. The findings of this research seem to be very promising, the extensive green roof mock-up has the least environmental impacts for all impact categories except for the “land occupation” impact category due to the vegetation layer. Moreover, a real-time monitoring of temperature was done to assess the electricity consumption or both TBR and EGR mock-ups within the use phase. Furthermore, the sensitivity and uncertainty analyses will be performed to check the robustness of the results.

WE221
Filling whole building life cycle assessment gaps for conceptual building design

Y. Hao, University of Pittsburgh; J. Chhabra, G. Warn, Pennsylvania State University; M. Bilec, University of Pittsburgh / Civil and Environmental Engineering

Resource consumption, harmful emissions, climate change, and hazard events have triggered increased interest in sustainable and resilient buildings over the past 20 years. The sustainability and resilience performance of buildings has been covered in numerous rating systems and building codes; however, these are typically prescriptive methods focused on setting minimum performance requirements rather than helping us understand and optimize buildings. Life cycle assessment (LCA) and performance-based methods (e.g., energy modeling, seismic loss assessment) can be more beneficial from this standpoint but can be complex and isolated from each other. Most building LCA studies to date have limited their scope to embodied and operational energy use, due to their overwhelming impacts in conventional buildings, while some aspects, such as repair from damages (e.g., seismic) and water use have been largely missing. This study uses LCA, energy modeling, water modeling, and seismic loss assessment simultaneously to obtain a comprehensive understanding of the costs and environmental impacts of high-performance building design alternatives. Preliminary analysis of a hypothetical building shows that in some metrics, such as cost and eutrophication, repair and water phases, respectively, can contribute more than 10% over the lifetime of the building. One design parameter expected to influence all of the mentioned performance aspects is the building form-factor, and its effect on the results will be presented. Based on the typical approach to building LCA and the shift in the sources of impacts away from operational energy as buildings transition to net-zero energy, this study investigates the potential contribution from missing phases in building LCA. This research brings together knowledge from multiple disciplines and links them through life cycle thinking, investigating the effects of building design decisions in multiple metrics. This approach can be crucial in identifying optimal solutions early on during the conceptual building design phase.

WE222
Prospects for multidimensional assessment of sustainability in urban environments

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Urban systems can be considered as living organisms driven by materials and energy flows (urban metabolism). Once these flows are computed, the environmental profile of the city can be analysed. However, when only assessing the environmental aspects of cities, a limited view of their performance is possible, as they are complex systems in which social and economic aspects are at least as important as environmental ones. This fact raises a dilemma, since today’s developed society bases its growth on the social and economic wellbeing of its inhabitants, not only on the consumption of resources and, therefore, on causing a large impact on the environment. The definition of sustainability includes three main pillars: society, economy and environment. However, considering the social and economic aspects of urban metabolism, two main gaps emerge. The first one is the lack of standardisation. Indicators are used to evaluate these aspects, but different specialized organisms propose different sets of indicators. The second gap is the difficulty of comparing indicators to each other in order to evaluate which city is the most sustainable in a sample. This study aims to fill both gaps by systematically assess the sustainability of several cities in Galicia (NW Spain). To select an appropriate set of indicators, including environmental, social and economic criteria, a Leopold matrix has been constructed considering: i) the data available for the system, ii) the frequency of occurrence in the data sets of specialized agencies (United Nations, European Commission, OECD and The World Bank) and iii) the relevance for the case study. The selected indicators do not have a significant common unit of measurement; therefore, to obtain a common scale for comparisons, all indicators should be normalized. In this study, this has been done by considering unsustainable and sustainable values as reference (Phillis et al., 2017). Finally, a composite indicator, i.e., a sustainability index, is obtained for each city based on the three composite sub-indicators of the sustainability dimensions (environmental, social and economic criteria). Acknowledgements This work was financially supported by the Spanish Ministry of Economy and Competitiveness (project ref. CTQ2016-75316-P) and by Xunta de Galicia (project ref. DO11431F-2016/6001). Dr. S. González-García would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness for financial support (Grant reference RYC-2014-14984).

WE223
Life Cycle Analysis of remediation solutions in railways and surrounding areas

M. Riera, Leitat Technological Center

An important environmental problem is the pollution associated with trains on external or underground railways. Despite is an issue less studied, a real contamination by heavy metals and hydrocarbons exists in railways, affecting also the surrounding areas. Following the strategic line of Horizon 2020, RECOVER project aims to develop new technologies to reduce the environmental impact of transport systems. The project is executed by COMSA, CETIM and LEITAT, and is within the framework of the call "Challenges of Collaboration" in 2015, with partial funding from the Ministry of Economy and Competitiveness of Spain. The
main aim of the project is to develop systems for the collection and elimination of pollutants (hydrocarbons and heavy metals) present in the basin and on the ground adjacent to the railway tracks through the use of different technologies: Ballast modified by sol-gel coating based on silicon oxide to capture heavy metals and titanium oxide for the degradation of hydrocarbons. Phytoremediation processes (use of plants to decontaminate soils) and bioremediation (bioaugmentation of the microbial population of the soil) for the uptake of heavy metals and hydrocarbons in the soil adjacent to the roads. The solutions are first performed at the laboratory scale, and subsequently they are located in a real area to evaluate their effectiveness. The remediation procedures are assessed through a comprehensive Life Cycle Assessment (LCA) to identify the environmental benefits obtained with the introduction of the solutions in railways. The environmental analysis includes the life cycle stages of raw materials, application and end of life scenarios, including transport and other related aspects. The LCA is performed based on the methodology which is standardized by the ISO 14040 and ISO 14044. Calculations are done using the SIMAPRO software and taking as a basis the Ecoinvent3.1 database. Besides the direct environmental benefits of the pollutants reduction in the soil, the LCA allows the identification of other environmental aspects. The impact categories and indicators that should be included in either road or asphalt mixtures. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixtures. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixtures. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. The analysis of the study presented here underlines the importance of addressing questions concerning the differences between the LCA of asphalt mixtures and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE226 Integrating Life Cycle Assessment and Risk Assessment to support decision making in the framework of Enhanced Landfill Mining G. Sanve, KU Leuven Research & Development / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering Life cycle assessment (LCA) tools are used to assess the environmental impacts of product systems throughout their life cycle. However, when addressing waste management strategies, and in particular landfills, this tool could lead to some limitations. Landfills are in fact highly complex systems and their impacts are affected by several site- and time-dependent parameters. When assessing the potential for enhanced landfill mining (ELFM), the relative perspective of LCA becomes important. Through identification of the potential environmental impacts and generate elevated GHG emissions. For this reason, great efforts are being made towards the integration of sustainable technologies and life cycle assessment perspectives. In order to u

WE227 Comparative environmental sustainability analysis of waste-to-energy techniques for municipal solid waste A.J. Ramos, INEGI / INEGI; A.J. Rouboa, University of Pennsylvania / Mechanic Engineering and Applied Mechanics Progressively advancing societies generate increasingly complex mixtures of residues which led waste thermal treatment methods to evolve greatly in the last decades [1]. Incineration is among the most waste-to-energy (WtE) techniques used for solid residues treatment [2], still gasification is gaining notoriety due to its proven benefits namely concerning efficiency indicators and environmental outputs [3, 4]. Three waste-to-energy techniques for the treatment of municipal solid wastes were considered through a life cycle analysis (LCA) perspective and compared so as to evaluate their environmental impacts: incineration, regular gasification and two-stage plasma gasification. The functional unit chosen was one tonne of residues within similar boundary conditions for each technique. Incineration has shown a sustainable profile, tonnes of debris saving up to 1.3 million kg of resources and materials, while environmental indicators such as global warming potential (GWP), eutrophication potential (EP) and terrestrial ecotoxicity potential (TETP) depicted enhanced results. Regular gasification uses higher temperatures, thermally decomposing waste and originating syngas which may be utilised as feedstock for further applications. Its environmental impacts revealed poor results in RECOVER project could an important contribution to the current railway legislations. The main objective of demEAUmed is to tackle water scarcity in the Mediterranean tourist facilities: DemEAUmed solution

WE225 Sustainability assessment of an integrated innovative wastewater and greywater system for an optimal and safe closed water cycle in Mediterranean tourist facilities: DemEAUmed solution

() to identify the environmental benefits obtained with the introduction of the solutions in railways. The environmental analysis includes the life cycle stages of raw materials, application and end of life scenarios, including transport and other related aspects. The LCA is performed based on the methodology which is standardized by the ISO 14040 and ISO 14044. Calculations are done using the SIMAPRO software and taking as a basis the Ecoinvent3.1 database. Besides the direct environmental benefits of the pollutants reduction in the soil, the LCA allows the identification of other environmental aspects. The impact categories and indicators that should be included in either road or asphalt mixtures. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixtures. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixtures. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. The analysis of the study presented here underlines the importance of addressing questions concerning the differences between the LCA of asphalt mixtures and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE224 Life Cycle Assessment of Asphalt Mixtures vs Road Pavements D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC; A. Jimenez del Barco Carrion, The University of Nottingham Road infrastructures are one of the major assets all over the world. The appropriate construction and maintenance of roads promote economic growth and development of countries. Within the field of road infrastructures, road pavements construction and maintenance require particularly high energy and raw materials consumption and generate elevated GHG emissions. For this reason, great efforts are being made towards the incorporation of sustainable technologies and life cycle assessment perspectives. In order to u

Life Cycle Assessment (LCA) to identify the environmental benefits obtained with the introduction of the solutions in railways. The environmental analysis includes the life cycle stages of raw materials, application and end of life scenarios, including transport and other related aspects. The LCA is performed based on the methodology which is standardized by the ISO 14040 and ISO 14044. Calculations are done using the SIMAPRO software and taking as a basis the Ecoinvent3.1 database. Besides the direct environmental benefits of the pollutants reduction in the soil, the LCA allows the identification of other environmental aspects. The impact categories and indicators that should be included in either road or asphalt mixtures. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixtures. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixtures. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. The analysis of the study presented here underlines the importance of addressing questions concerning the differences between the LCA of asphalt mixtures and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE225 Sustainability assessment of an integrated innovative wastewater and greywater system for an optimal and safe closed water cycle in Mediterranean tourist facilities: DemEAUmed solution

A. Clare, C. Hidalgo, Leitat Technological Center / Sustainability Division; S. Vives, CONCEPCIO TARRADES, CONCEPCIO TARRADES / LEITAT TECHNOLOGICAL CENTER / Sustainability Division

The main objective of demEAUmed is to tackle water scarcity in the Mediterranean area, especially in places with high tourist activity. Also, the project wants to foster the incorporation of sustainability aspects in the tourism sector. To achieve both challenges, demEAUmed has demonstrated the integration of innovative wastewater and greywater systems for an optimal and safe closed water cycle in Mediterranean tourist facilities. Water resources are limited and unequally distributed geographically and among the year seasons, with higher water cycle in Mediterranean tourist facilities. Water resources are limited and unequally distributed geographically and among the year seasons, with higher water cycle in Mediterranean tourist facilities. The solutions are first performed at the laboratory scale, and subsequently they are located in a real area to evaluate their effectiveness. The remediation procedures are assessed through a comprehensive

WE228 Life Cycle Assessment of Pharmaceutical Waste Disposal in the UK S. Mohamed Yunus, University of York / Environment; A. Boxall, University of York / Environment Department; E. Igos, Luxembourg Institute of Science and Technology / Environmental Research and Innovation

Unused or expired medicines from the hospital and household waste can ultimately end up in landfills or be released to the wastewater system. Therefore, there is the potential for active pharmaceutical ingredients (APIs), from a range of medicinal products, to be present in landfill leachate and sewage effluents. Unused medicines may also be returned to the pharmacist and then be incinerated as hazardous waste. In this project, a household survey was performed to understand the typical waste generation patterns for medicines and the most disposal routes for these substances in the UK. The results show that rubbish disposal (34%) is the common disposal method in the UK residents with highest estimated emission of APIs to the environment being estimated for paracetamol within the range 7.63 mg/person/day (sewage after sink and toilet disposal) to 76.52 mg/person/day (wastewater after excretion). Based on the survey data, a life cycle assessment study was performed to assess the broader environmental impacts of typical medicinal waste disposal management practices in the UK. The functional unit of this study was 1 tonne of pharmaceutical waste generated in the UK. Three scenarios and treatments were explored: incineration after returning back to the pharmacy; landfill treatment after rubbish disposal; and wastewater treatment after toilet and sink disposal. For the life cycle inventory (LCI) phase, two types of databases were used in the study: primary data from the survey study and secondary data from the ecoinvent database. Most of the datasets used in this study are from the whole of Europe (ERB) or the United Kingdom (GB). To carry out the life cycle impact assessment (LCIA) phase, the method that has been considered is LCID 1.0.8 2016 midpoint with APIs. Meanwhile, USEtox 2.0 was also used in this study to calculate characterisation factors for the APIs that were not commonly used in the previous study. Furthermore, the impact categories that were considered for this study are climate change, ecosystem quality, human health and resources. The study is still ongoing and the results will be presented at the event.

WE230 Streamlined life cycle assessment of emerging batteries in early design phases using CCaLC tool C. Tomasini Montenegro, KIT, Karlsruhe Institute for Technology; M. Wei, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

Tomasin-Montenegro, C.*; Wei, M. ; HHI, Helmholz-Institute Ulm, Germany ; ITAS, Institute for Technology Assessment and Systems Analysis, Karlsruhe, Germany ; KIT, Karlsruhe Institute for Technology, P.O. Box 3640, 76021 Karlsruhe, Germany In our modern and globalized society, meeting energy needs in a sustainable way poses one of the biggest challenges for the scientific, political and regulatory bodies around the world. Therefore, in the context of the United Nations Development Goals, affordable and clean energy access has been defined as a reachable goal for 2030. In addition to the social impacts associated with this action plan, both tackling climate change and defining regulatory and market frameworks are common elements to identify global solutions for a low carbon energy market. In particular, considering an action plan is necessary to reach a decarbonized energy supply. In this context, improving the structure of supply chain engagement over developing and developing countries (e.g., Kagawa et al., 2015). Moreover, with expansion of trade and the international fragmentation of productions, the promotion of free trade has been increasingly required. In this context of “mega-regional” Free Trade Agreement have been identified as significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental burdens simultaneously through the cooperation between the participating countries. To decide the cooperation policy for reducing environmental burden, it needs to understand the structure of complicated supply chain network. Without a clear understanding of the supply chain network, it is difficult to evaluate the impacts on the environmental burden simultaneously through the cooperation between the participating countries. Therefore, the method of environmental life cycle assessment is used in this research, the applied practical path betweennessness (Liang et al., 2016; Hanaka et al., 2017) to EORA database (Lenzen et al., 2012, 2013) and analyzed the critical sectors for the cooperation policy in the global supply chain network. From the centrality analysis, it is identified the critical sectors and transmitters. In the case of TPP framework, the largest CO2 emitter are “JPN_Electricity, Gas and Water” and “CHN_Electricity, Gas and Water.” On the other hand, the largest CO2 transmitter are “RUS_Mining and Quarrying”—“JPOL_Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “CHN—JPN” in the country level. We can see the large CO2 emitter from China and Russia which are part of the TPP framework is imported to Japan through the use of TPP members. In the cases of other FTA framework, similarly, mining and qualifying sectors in Russia and China tend to be critical sectors. Replacement of the mining goods suppliers is not easy. Therefore, FTA member countries should make a guideline for acquisition of greener materials and parts produced in the critical sectors.

WE231 Developing life cycle assessment to fight climate change P. Goglio, Cranfield University / School of Water, Energy and Environment; A.G. Williams, N. Baltz-Ozkan, N. Harris, Cranfield University / School of Water, Energy and Environment; P. Williamson, University of East Anglia / School of Environmental Sciences; A. Marvuglia, Luxembourg Institute of Science and Technology (LIST) / Environmental Research and Innovation (ERIN); P. Baustert, Luxembourg Institute of Science and Technology LIST / Resource Centre for Environmental Technologies (CRTE)

Climate change targets could only be achieved with the contribution of greenhouse gas (GHG) emissions from several GGR (Global Gas Recovery) technologies. Life Cycle Assessment (LCA) is a key technique for GGR technologies. Two different Life Cycle Assessment (LCA) studies are presented: (i) a preliminary analysis of emerging technologies; and (ii) a study on the potential of recycling strategies for LCA of GGR technologies. Firstly, (i) presents a system boundary and life cycle inventory (LCI) for emerging technologies. Secondly, (ii) investigates the potential of recycling strategies for the LCA of GGR technologies and (ii) discusses their strengths and weaknesses. The preliminary comparison and development of approaches was based on a bibliographic review combined with expert discussions. The approach has been classified according to their completeness, uncertainty and complexity, several approaches were discussed: combining LCA with agent based modelling; combining LCA with climate scenarios from integrated assessment model IAM (IAM) used to assess future trajectories for GHG and climate change; combining socio-political factors with consequential LCA or using agent-based modelling for the socio-political factors affecting the choice of results from the equilibrium

Y. KURAHARA, N. Isubo, Tokyo City University

In 2014, the UNEP/SETAC life cycle initiative published a guidebook regarding hotspots analysis which enables to extract important elements from the life cycle. They defined this method as “a methodological framework that allows for the rapid assimilation and analysis of a range of information sources, including life cycle based studies, market, and scientific research, expert opinion and stakeholder concerns. The outputs can be used to identify potential solutions and prioritize actions around the most impactful economic, environmental, ethical and social sustainability impacts”. Therefore, the scope of hotspots analysis covers environmental and social aspects. The methodology of environmental hotspots analysis has been developed in Japan using latest Japanese inventory database IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). The spatial and functional boundary are defined by using this calculation tool. However, the case number of studies using hotspots analysis tool are few, and advantages and limitations are unknown. In this research, we used the usefulness of environmental hotspots analysis through a variety of case studies for Japanese products.

WE233 Environmental burden reduction in the FTA framework using network analysis S. Tokito, Kyushu University

The CO2 emissions embedded in international trade have rapidly increased in countries with lax environmental regulations with expansion of trade and the emission from China and Russia which are part of the FTA framework is imported to Japan through the use of TPP members. In the cases of other FTA framework, similarly, mining and qualifying sectors in Russia and China tend to be critical sectors. Replacement of the mining goods suppliers is not easy. Therefore, FTA member countries should make a guideline for acquisition of greener materials and parts produced in the critical sectors.
models in consequential LCA. None of the approaches presented resulted fully comprehensive, with limited uncertainty and complexity. Both approaches based on agent based modelling require a large amount of data and expertise to be used, not often available to the LCA practitioner. The weighted consequential approach has a level of subjectivity higher than other approaches. Instead, the scenario based approach using IAM has a medium level of completeness, uncertainty and complexity. However, in both cases the agreement with the IAM assumptions to be used and this constitutes a major limit. The choice among the approaches depends on the objectives of the LCA and should be as complete and comprehensible as possible when climate change claims are made. Future perspectives include a comparative testing of these approaches for selected GGRT and future research should develop and assess potential alternative approaches to those presented. Further research is necessary to develop the appropriate LCA methodology for GGRT.

WE235 HYBRID FULFILMENT-IMPORTANCE MATRIX FOR ASSESSING SOCIOECONOMIC IMPACT
I. Esté Gallart, Fundacio CTEM, Centre Tecnologic; J. Bezzova, L. Vendrell, Fundació CTEM Centre; F. Clares, Fundació CTEM Centre Tecnologic
More often, methodologies to assess socioeconomic impact are focused just on determining just a few indicators instead impacts, which don’t use to cover the whole spectrum of socioeconomic insights. In this sense, the hybrid fulfilment-importance matrix emerges with the aim to solve these limitations and to cover the socioeconomic impacts of a new product or project. This methodology is not only based in technical performance of the studied system, but also in the holistic approach offered by the LCA, LCC and sLCA methodologies. This semi-quantitative system is based on the scores of the relationship between indicators and impacts. In this way, this methodology allows calculating in which degree the objectives have been achieved, and how the impacts and indicators affect the system. One of the main strong points is its integrated approach which allows to consider the impacts of the project during different dimensions of the project. The indicators, placed in rows, are organized in four categories: technical indicators, environmental indicators, economic indicators, and social indicators. For technical indicators, data coming from performance of the system is implemented. The indicators for the environmental category are taken from LCA studied impact categories, which are supposed to be relevant for the project. In the case of the economic category, indicators studied in the LCC study are considered. Regarding the social indicators, those listed come from sLCA study. The distribution of the columns shows two parts: the fulfilment part, and the relevance part. In the fulfilment part, three columns are deployed: Baseline status, expected results set and current and final results. On the importance part, the added columns represent the impacts of the project, which entail technical, sustainability, economic and social insights. When the impacts are selected, its importance in reference to the studied indicators must be defined based on expert know how and opinion. This importance is set by applying a value between 0 and 3. The socio-economic scores are calculated combining the importance values with the fulfilment scores. As a case study, this methodology has been applied to LIFE Agroindustry Brazilian Agricultural Research Corporation Embrapa / Embrapa Tropical Agroindustry.

Environmental monitoring of contaminants using terrestrial ecological biomonitor (P)


WE240 Semi-volatile organic contaminants (SVOCs) in pine needles from Iceland M. Moeenfar, J.A. Silva, S. Ramos, LEPABE University of Porto / 2 L. Vendrell, V. Lemos / 2 N. Ratola, Faculty of Engineering - University of Porto / Laboratory for Process Engineering, Environment, Biotechnology and Energy Iceland is famous for a great number of things, but vegetation (particularly forestry) is not one of them. However, trees do exist in this country and pine stands and rarely widespread and the coastal areas. However and sport. In the case of the mosses it was possible to collect needles from more than one species, allowing a comparison between their respective uptake abilities for SVOCs. In this work the levels of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), organochlorine pesticides (OCPs) and musks were analysed and allowed an original description of the distribution of these in this component in this remote location. Acknowledgements: This work was the result of the project: (i) POCI-01-0145-FEDER-006939 (LEPABE – UID/EQUI/00511/2013) funded by the European Regional Development Fund.

A life cycle inventory for MK-TPS was implemented based on primary data gathered at a laboratory scale. Six environmental impact categories were assessed based on the ReCiPe Life cycle impact assessment method. A sensitivity analysis to the allocation approach for the starch extraction process will be performed comparing mass allocation (56 % starch, 28 % phenolic compounds and 16% oil) with economic allocation (using a range of expected market prices). Impacts based on economic allocation for MK-TPS show lower climate change, fossil depletion and ozone depletion, but higher impacts on terrestrial acidification, freshwater eutrophication and marine eutrophication, comparatively to LDE. The most important contributor to impacts is starch extraction (due to hexane and methanol), except for marine eutrophication, for which the main contributor is glycerin used to produce the thermoplastic. The paper may contribute to the eco-design of a new biomass-based product using an agro residue from the biokraftagro industry as feedstock, through a Life cycle assessment based on laboratory scale data. Future studies shall take into consideration critical aspects and improvement opportunities identified through the study on a larger scale extraction process.

WE236 SETAC Sustainability Interest Group
D.L. Carpenter, Texas Tech University / Biological Sciences

WE237 SETAC LCA Interest Group (Europe)
H. Sticknoth, Technische Universität / Agricultural Technology

WE238 Life cycle assessment of a thermoplastic starch obtained from mango kernel A. Cárdenas, Agroindustria Embra, Agricultural Research Corporation / Embra, Tropical Agriculture: P. Marques, F. Freire, University of Coimbra / ADANI-ALTAIA, Engineering, P. Melo, Federal University of Ceará; M. Figuerêdo, Brazilian Agricultural Research Corporation Embra, Tropical Agriculture: Agrifood industry generates large amounts of residues with potential to be used as feedstock for bio-based products, Mango fruit annual production in Brazil is expected to increase to 1.4 million tons by 2024, and processing residues can account for more than 40 %. The mango pulp is the main product, and mango kernel, a so-called residue, is disposed of at landfill, but containing starch, oil and phenolic substances. This study assesses the environmental life cycle impacts of thermoplastic starch produced from mango kernel (MK-TPS), and compare it with fossil based low-density polyethylene (LDPE). The system boundaries of the MK-TPS start with transportation of mango kernel residue, followed by extraction of starch from mango kernel (together with oil and phenolic substances), and production of thermoplastic. The functional unit adopted was 1 kg of thermoplastic.
The use of lichens as biomonitors of air quality is inexpensive and effective. The association between mercury and lichens is stable over a one year period with intensive monitoring to confirm spatial patterns. Lichens were also collected from one old reforestation area, Eucalyptus, and Rawlinsia, a lichen with a long range transport of anthropogenic air pollution. The region also contains a hazardous waste incinerator (Huerto Ille) that produces significant emissions of mercury, lead, and selenium (n=163). Average levels of polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) in the vicinity of the hazardous waste incinerator have been reported to be similar to those observed in the scientific literature for other industrialized areas. The current study assessed pollutant distribution in terms of bioavailability and biological responses in a lichen community. Monitoring of mercury and other trace metals levels and biological responses investigated and with the distance from the incinerator were found to be higher in the vicinity of the incinerator. Comparing the study of 1998 with 2015, 1998-2016, and 2015, the median concentrations of CD/Fs in soil samples collected around the Huerto Ille were 0.46 pg I-TEQ/g (dw) (range: 0.14 to 1.96 pg I-TEQ/g (dw)) and 0.44 pg I-TEQ/g (dw) (range: 0.13 to 1.34 pg I-TEQ/g (dw)) in 2015 and 2016, respectively. No statistical differences were found between 2015 and 2016 campaigns. Comparing the study of 1998 (median: 0.75 pg I-TEQ/g (dw)) with these carried out in 2015 and 2016, the concentration of PCDD/Fs statistically decreased by 41 and 55%, respectively. Median concentrations of PCDD/Fs in samples of vegetation collected in the vicinity of the incinerator were 0.2 pg I-TEQ/g (dw) (range: 0.11 to 0.68 pg I-TEQ/g (dw)) in 2015 and 0.17 pg I-TEQ/g (dw) (range: 0.09 to 0.36 pg I-TEQ/g (dw)) in 2016. The temporal trend of PCDD/Fs in vegetation was very similar to that of soil, with overall reductions of 4%, 30% and 27% over the period 1998-2015, 1998-2016, and 2015-2016, respectively, being statistically significant in the two latter periods. Although the concentrations of PCDD/Fs in both soil and vegetation samples collected in urban areas showed higher levels than those from rural areas, there was no direct relationship between the levels of PCDD/Fs and the direction or proximity to the plant. In addition, the comparison of PCDD/Fs profile of chimney emissions and the corresponding samples of soil and vegetation denotes noteworthy differences in the contribution of some congeners. Consequently, there is a low potential impact of the plant on the environment, regarding to the emission of PCDD/Fs. Finally, concentrations of PCDD/Fs in soils and vegetation here reported are similar and/or below those observed in the scientific literature for similar areas.

**WE245**

The use of land snail Cornu aspersum as sentinel organism to monitor air pollution

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The use of biomonitoring organisms for monitoring air pollution allow to assess real hazardous effects of airborne contamination over a geographical and temporal scale depending on selected species and scientific approach. The present study aimed to validate the use of the land snail Cornu aspersum as bioindicator of airborne pollutants effects by transplanting snails in plastic cages positioned in urban area strongly impacted by several industrial activities nearby. Ten sites were selected based on air pollution data and transects were drawn from the main urban area in order to assess pollutant distribution in terms of bioavailability and biological responses in a relatively short period of time. After four weeks trace metals levels in soft tissues of whole organism and several biochemical responses were investigated in different tissues and organs as: l-lysosomal membrane stability (LMS) and Microcunnei (MN) in hemeocytes and antioxidant enzymes Catalase (CAT) and Glutathione-S-transferase (GST), lipid peroxidation (MDA) and total Metallothionein proteins content (MTI) in midgut. Results obtained by generalized linear mixed models (GLMMs) revealed significant correlations among trace metals levels and biological responses investigated and with the distance from the landfill.
The relationship between lead exposure on dogs and their behavior around Pb mining area, Kabwe, Zambia

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Lead (Pb) toxicity on both human and animals has been known and causes neurological symptoms and even death in the worst cases. Our previous study has revealed Pb exposure on domestic dogs around a Pb mining area, Kabwe, Zambia. There was a trend that Blood Lead Levels (BLLs) in dogs in sites near to the mining area were higher than those in sites far from the mining area. Moreover, the difference of BLLs in the same area among individuals was found. This difference may be attributed to some factors, and behavior of dogs could be one of the important factors. The present study was undertaken to determine a relationship between Pb exposure on domestic dogs and their behavior recorded using GPS machines around the mining area in Kabwe, Zambia. Blood samples of domestic dogs which were freely roaming in the area were collected twice before putting GPS and after a week. BLLs were analyzed by LeadCare II. GPS devices were set to log every 1 minute and 30 seconds and attached to dog collars. In total, 53 male and 48 female domestic dogs were sampled. The overall mean of BLLs before and after a week were 24.9 ± 10.1 μg/dL and 23.6 ± 10.1 μg/dL, respectively. There was no significant difference between BLLs before and after a week. GPS log data was averaged collected for 4.4 days and the means of distances of dog movements per day was 17.6 km. There was no significant relationship between distances of dog movements per day and the gap of BLLs in dogs between before and after a week. The distance between the mining area and dog's home was significantly negatively correlated with BLLs (p < 0.05). The previous study revealed the concentrations of Pb in soils were negatively correlated with distance from the mine. These trends suggest that the distance from the mine is a key factor of Pb exposure on dogs. In the present study, there was a significantly negative correlation between BLLs and the gap of BLLs in dogs between before and after a week. In contrast to our hypothesis, there was no significant relationship between BLLs in dogs and their behavior. It suggested that mature dogs in the study area could be highly exposed to Pb regardless their behavior. An additional study focusing on the behavior of young dogs which are more vulnerable to Pb could get a different result of the relationship with their Pb exposure.

WE249
Cr transport in sweet peppers plants cultivated with vermicomposted tannery wastes

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Untreated waste water and solid waste generated by the tanning industry can cause serious environment damage, particularly to surface and groundwater. In order to avoid pollution, specific chemical, physical and biological treatments have been adopted to reduce waste toxicity, mainly by the presence of the chromium. Chromium exists in oxidation states of Cr (III) and Cr (VI). As it is well known, the trivalent oxidation state is the most stable form of chromium and it is essential to plants in trace concentrations. In other hand, the hexavalent is toxic and carcinogenic to mammals, even in small concentrations. Thus, the aim of this work was to investigate the Cr transport in sweet peppers cultivated with vermicompost. In order to investigate the Cr transport in sweet peppers, we have examined the chromium concentration in the different parts of the plant, after using the vermicompost and its possible transportation through the plant, the content of Cr (III) and Cr (VI) were evaluated in all the binary soil-plant: soil (at begging and post-harvest), roots, stalk, leaves, and mature fruits. Cr (III) and Cr (VI) were determined through graphite furnace atomic absorption spectroscopy (GF AAS). Values of Cr (VI) were below the detectable level (LOQ) in all the analysis. In general, all treatments showed a decrease on their Cr (III) content during the sweet pepper cultivation. The concentration of Cr (III) varied in leaves < stalks < roots < fruits. Values of chromium were in accordance with the maximum permitted in the Brazilian legislation for food security; Cr (VI) was not reported in any sample. A significant quantity of Cr (III) decreased between the concentration at the beginning and at final experiments (post-harvest). Assessing the dynamics of the Cr (III), root absorption seems to be the key factor of Cr (III) decrease followed by the leaves. Differences in the chromium contents were not observed between samples and treatments which received vermicomposted tannery wastes with others, without addition of chromium residues. Keywords: vermicomposting; tannery wastes; chromium; sweet pepper

WE250
Insecticide resistance in the natural enemy F. auricularia: detoxification pathways and sensitivity of acetylcholinesterase to organophosphate insecticide.

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disruption practice), and organic ones. Two frequently involved in pesticides resistance enzyme families: Glutathione-S-transferases (GST) and Carboxylesterases (CbEs) were studied, by measuring their activities on earwigs extracts. Acetylcholinesterase (AChE) activity, the molecular target of OP insecticides, was monitored as toxicological endpoint. We observed that the mortality rate of adult earwigs exposed to the authorized dose of chlorpyrifos depends on their origin, suggesting that the susceptibility of earwigs from conventional orchards. AChE activity appears to be highly inhibited in earwigs from organic or IPM compared to conventional orchards. Moreover AChE inhibition increased when earwigs were exposed to both chlorpyrifos combined to a specific inhibitor of ChEs. Moreover, we observed that basal-activities of ChEs and GST of unexposed individuals are higher in conventional orchards compared to IPM and organic ones. All these observations support the hypothesis of a molecular target modification in AChE causing to a decrease of affinity with the insecticide, and highlight the role of ChEs ensuring effective protection of AChE. Our findings suggest the acquisition of resistance to chlorpyrifos in earwigs caught in conventional orchards and point out the necessity to understand these mechanisms in order to evaluate their relevance as biocontrol agents.

WE251
Bioaccumulation of persistent halogenated organic pollutants in insects: Common alterations to the pollutant pattern for different insects during metamorphosis
L. Yu, Guangzhou Institute of Geochemistry / State Key Laboratory of Organic Geochemistry; and Guangdong Key Laboratory of Environmental Resources Utilization and Protection; X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem; L. Tao, Guangzhou institute of Geochemistry Chinese Academy of Sciences; Y. Zeng, B. Mai, Guangzhou Institute of Geochemistry Ubiquitous use of halogenated organic pollutants (HOPs), such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and dichlorodiphenyltrichloroethanes (DDTs), can accumulate in organisms and become magnified along the food chain. Insects play an important role in the transformation of pollutants from abiotic to biotic media. However, few studies have been discussed the accumulation and fate of contaminants in insects. Furthermore, metamorphosis effects on the stable isotope signatures and enrichment characteristic of contaminants in insects, but the bioaccumulation pattern and mechanism during metamorphosis is not well understood. Therefore, we detected the concentrations of halogenated organic pollutants in four taxonomic insects (dragonfly, butterfly and moth, grasshopper, and litchi stinkbug), including three kinds of metamorphosis type, collected from an e-waste pollution region in South China. Stable isotopic analysis showed grasshopper have the highest $\delta^{13}$C, indicating a C$_3$-plant-based food source. In contrast, the butterfly, moth, and litchi stinkbug all represent a C$_4$-based diet preference characterized by lower $\delta^{13}$C values. Moreover, enrichment of the heavy N isotope during metamorphosis is observed in the dragonfly and litchi stinkbug, but the other species (grasshopper, butterfly and moth) did not show significant increases in the values of $\delta^{15}$N from larvae to adults. Principal component analysis (PCA) was conducted using the fraction contaminant of HOPs were performed to evaluate the species-specific bioaccumulation. Different species of insects exhibited different contaminant patterns, which could be attributed to their habitats and feeding strategies. For example PBDEs were predominant in the dragonfly collected from the pond, which has been seriously contaminated by electronic waste; however, DDTs significantly contributed to the total HOPs in the butterfly and moth, and in the litchi stinkbug, and their host plants also have a high DDTs concentration. In addition, a common multi-linear correlations between In adult/larva and log $K_{OW}$ of the compound was observed for the four taxonomic insects. The ratio of larva to adult decreased with increasing values of log $K_{OW}$ (log $K_{OW}$ = 6-6.5), then increased (6 < log $K_{OW}$ < 8) and decreased again (log $K_{OW}$ > 8). The results of this study demonstrated that a common mechanism is responsible for the fate of HOPs during metamorphosis in those insects.

WE252
Glyphosate: toxic or not toxic, this is the question.
M. Verdenaro, R. Scudiero, University Federico II / Department of Biology In recent years, the environmental and public health concerns toward glyphosate-based herbicides (GBH), a broad spectrum herbicide widely used in agricultural, industrial and urban areas, is a great matter of debate. Although classified by the EPA as “non-toxic and not an irritant” and by the EFSA as “no carcinogenic to humans”, converging evidence suggests that GBHs, such as Roundup (Monsanto), pose serious health risk. These studies allow to outline comparisons over space and time and provides significant ecotoxicological integrated measures of the selected metals within the studied system. This study aimed to assess the levels of metals (As, Cd, Cu, Cr, Ni, Pb and Zn) in different tissues (muscle, hepatopancreas and gills) of G. cruenta and compare populations from contaminated and non-contaminated areas. Samples were collected in two mangrove areas, the SE of Brazil and PA State, Brazil. The study was conducted during a period of one year, to assess the bioaccumulation of metals associated with seasonality. A two-way ANOVA was carried to analyze interactions between season and sites. The results showed high concentrations of metals in the gills, which was considered a strong reflection of high exposure of G. cruenta to these contaminants. In general, the hierarchical pattern of metals concentration in organs was represented by gills>hepatopancreas> muscle, except for Zn. There were significant differences in metal levels between seasons and sites (p<0.01). The highest concentrations were observed in the summer, which corresponds to the period of greatest metabolic activity of the organisms. Surprisingly, organisms from

WE253
Concentration of perfluoralkyl substances decreases according to the laying order in the yolk of yellow-legged gull eggs

Many studies demonstrate that GBHs threaten the reproduction of vertebrates such fish and mammals GBHs interfering with the activity of aromatase, an important enzyme involved in the production of testosterone. Moreover, in vertebrates such fish and mammals GBHs, such as Roundup (Monsanto), pose serious health risk on the Italian wall lizard P. sicula. Our findings suggest the acquisition of resistance to chlorpyrifos in earwigs caught in conventional orchards and point out the necessity to understand these mechanisms in order to evaluate their relevance as biocontrol agents.

WE254
First assessment of metal concentration in the crab Goniopis cruenta (Legnol, 1803) (Decapoda, Grapsidae) from two brazilian mangroves areas with different levels of contamination
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The crab Goniopis cruenta is a common semi-terrestrial species in brazilian mangroves. Its geographical range includes the western Atlantic Ocean from Bermuda to Brazil, and the eastern Atlantic Ocean from Senegal to Angola. The species is an important fishery resource for traditional communities in the some regions of Brazilian coast. These ecosystems are located in regions of intense anthropic activity and have been proved to accumulate heavy metals. The use of conventional pest management practices allows to outline comparisons over space and time and provides significant ecotoxicological integrated measures of the selected metals within the studied system. This study aimed to assess the levels of metals (As, Cd, Cu, Cr, Ni, Pb and Zn) in different tissues (muscle, hepatopancreas and gills) of G. cruenta and compare populations from contaminated and non-contaminated areas. Samples were collected in two mangrove areas, the SE of Brazil and PA State, Brazil. The study was conducted during a period of one year, to assess the bioaccumulation of metals associated with seasonality. A two-way ANOVA was carried to analyze interactions between season and sites. The results showed high concentrations of metals in the gills, which was considered a strong reflection of high exposure of G. cruenta to these contaminants. In general, the hierarchical pattern of metals concentration in organs was represented by gills>hepatopancreas> muscle, except for Zn. There were significant differences in metal levels between seasons and sites (p<0.01). The highest concentrations were observed in the summer, which corresponds to the period of greatest metabolic activity of the organisms. Surprisingly, organisms from
unpolluted regions, accumulated more metals than from polluted areas. Thus, we concluded that there are external factors (rainfall, runoff, fertilization) that reduce the mobilization of these chemicals to the tissues and, consequently, their bioavailability to the local biota. Therefore, studies of metal concentrations in mangrove areas are relevant and useful for monitoring the health of environment, maintenance of biodiversity, and for assuring the quality of life, mainly for human consumption.

WE255 Maternal Transfer of persistent halogenated organic pollutants in Watersnakes (Enhydrid chinesis)

X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem.; L. Bai, Guangzhou Institute of Geochemistry; Chinese Academy of Sciences / State Key Laboratory of Organic Geochemistry; B. Mai, Guangzhou Institute of Geochemistry

Halogenated organic pollutants (HOPs) such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenyldichloroethanes (DDEs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the offspring equals or exceeds dietary uptake by young fishes. Few studies are focus on viviparous species, but ovooviviparous species have not yet been studied. It is known that watersnake (Enhydrid chinesis) was ovooviviparous species. Their fertilized eggs develop into new individuals in the maternal body before producing offspring. The source of contaminants in watersnake eggs mainly derived from maternal tissues. In order to fully elucidate the deposition of contaminants in eggs, firstly, the lipid-normalized concentration ratios of egg to muscle (EMR) were usually used to assess maternal transfer efficiency of contaminants in oviparous organisms. Secondly, due to relatively high lipid and weight of egg in watersnake, the ratios of contaminant burden in egg over the sum in muscle and egg (EMER) was used to evaluate the tissue distribution of contaminants in watersnake eggs. The values of EMR, and EMER were respectively 2.93 and 95% for PCBs and 0.35 and 68% for PBDEs. Meanwhile, DDTs, PCBs, PBB, HBB, PBB 153 and lower brominated BDE congeners showed the ratios of EMR, and EMER higher than 1 and 88% (the lipid percentage of egg to egg plus muscle), respectively. The results indicated that these chemicals were readily transferred from muscle to egg or preferential accumulation in egg compared with muscle. Other chemicals, such as higher-brominated BDE congeners, DP, PBB209, and DBDEP, showed ratios of EMR, and EMER lower than 1 and 88%, respectively, indicating less readily maternal transferred or a preference for muscle. A multi-linear relationship exists between EMER and log Kow of the chemicals for the watersnake. For compounds with high hydrophobicity (log Kow > 8), a negative relationship between EMER and log Kow is observed (p < 0.05). This relationship is used as an indicator of the difference between the value of land before and after transformations is representing the damages to the ecosystem quality. We performed a case study for the deployment of a 10 MW photovoltaic solar farm in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in the UK to the whole upstream life cycle impacts. This implies that despite the apparent advantages of ‘clean’ renewable electricity production at the deployment location, the majority of ecosystem service damages might be relocated to other parts of the world.

WE256 Development of a Multi-compound Multi-matrix Method for Analysis of Halogenated Flame Retardants Comprising a Multi-step Cleanup and Use of GC-API-MS/MS and GC-EMI-MS

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The ultra-trace analysis of halogenated flame retardants (HFR) leads more and more to the question of analyzing substances of actual or future relevance such as didechlorooxybenzenes and other dechloranes or novel brominated flame retardants together with legacy compounds as PBDEs. In order to address this issue, comprehensive analytical methods covering at the same time compound groups of different chemical substance groups from Dechloran Plus and other dechloranes as brominated benzenes and alkyl benzenes, ethers and esters (TBA, BPA, BDE, BPH, DPP, BDETP, AHTB, HTB, TBBP, Dec602, Dec603, Dec604, DMPA, Cl10-antiDP, Cl11-antiDP, syn-antiDP, antiDP, DBDEP). In this way, it gives an analytical basis for further extension towards other compound groups. We will show details of different analytical aspects of the method, especially regarding different column chromatographic clean-up steps and use of modern analytical equipment as e.g. GC-API-MS/MS-system, pointing out possibilities and limitations of such a broad scope of analytes.

Product benefits and positive outcomes: valuation and beyond (P)

WE257 A method to calculate carbon handprint

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Environmental impacts are typically assessed by measuring and modelling the negative effects that products, services and companies cause to the environment. In practice this means evaluating the used resources and energy and the emissions caused. However, many companies do not act in this way. Positive environmental impacts. The strong need for communicating the positive environmental impacts has been identified e.g. by Pihlola et al. (2010). Only, we lack systematic methods to quantify and communicate these impacts that are also called handprints. This presentation proposes a concept to assess and communicate the carbon handprint of a product. The method is in line with life cycle assessment methodologies and is built on the principle that reducing one’s own footprint is not a handprint. Instead, the handprint comes through improvements caused in the performance of another actor. The most fundamental parts of defining the carbon handprint are to recognize the mechanisms of forming the handprint and to determine the baseline. The carbon handprint can be created via more efficient material or energy use, by replacing or avoiding unwanted materials, waste reduction or extended service life and reuse. Also carbon capture and storage is a way to contribute to carbon handprint. The paper demonstrates through case studies situations where different approach for the determination of the baseline is required. The quantification of the carbon handprint requires several carbon footprints calculated in order to find out if the new solution or product actually reduces the carbon footprint of another actor or lifecycle stage. This is for example the case for the upstream life cycle of products from $2364/year to $1857/year, resulting in a target actor using the baseline solution, the new solution and the target actor using the new solution.

WE258 Assessing regionalised Life Cycle Assessment (LCA) and economic values of ecosystem goods and services: Impacts of upstream natural land transformations on ecosystem quality

A. Ayajebi, University of Exeter / Renewable Energy

Setting up operational and spatially-explicit sustainability assessment models with practical levels of data requirement is becoming more essential as the trend of globalising the economy is strengthening and accounting for impacts of human activities is becoming more complicated. Here we developed a model based on regionalisation of Life Cycle Assessment (LCA) that is capable of employing a holistic perspective while taking into account natural land transformations that are related to the life cycle processes. Furthermore, our model can interpret the impacts of land transformations on the ecosystem quality. Economic values of Ecosystem Services (ES) are used as an indicator of the difference between the value of land before and after transformations is representing the damages to the ecosystem quality. We performed a case study for the deployment of a 10 MW photovoltaic solar farm in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in the UK to the whole upstream life cycle impacts. This implies that despite the apparent advantages of ‘clean’ renewable electricity production at the deployment location, the majority of ecosystem service damages might be relocated to other parts of the world.

WE259 Recent advances in natural capital accounting


At the recent World Forum on Natural Capital (27-28 November 2017) a wide range of incorporated methods that can be used to answer the question of how much the natural capital is worth. The main insights are: (i) natural capital can be easily substituted by manmade capital, when in fact it cannot; and (ii) we lack appropriate political and economic institutions to manage natural capital effectively. Two opportunities emerge
including all natural capital could support greater prosperity if it were more appropriately valued and hence more efficiently used. The second is governance regimes based on scientifically informed political decisions should protect natural capital. Governance of natural capital stocks should be informed by biophysical limits, potential irreversibility, thresholds and risks to essential function. At the global level, the UN Sustainable Development Goals apply to all countries and provide a foundation for such a governance framework. We are all consumers and beneficiaries of natural capital, but it seems clear that SETAC members can also inform the debate. As environmental scientists we can contribute to developing an understanding of criticality – the tipping points for ecosystems, in particular where these relate to chemical pressures. There are opportunities to work with economists to ensure natural capital accounting and valuation is accurate and measurable, preferably quantitatively. One of the strongest themes was that we all need to improve our story telling across multiple disciplines and institutions.


The sustainability of hybrid-electric vehicles (HEVs) has been called into question (Bailey et al., 2017, Hickman, 2012, Publishers, 2008, Biello, 2016). With the recent onslaught of HEVs to the motor vehicle market, there is a need for the internalization of the costs—both environmental and economic—associated with one of its most valuable parts, the HEV motor. For this purpose, a screening Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) study has been carried out on the entire value chain of a dismantled HEV motor. The results of this study are analyzed quantitatively. The aim is to identify bottlenecks for such a quantitative analysis as well as to identify the hotspots from both an environmental and economic point of view. Furthermore, the results will serve as one of the important inputs in laying the foundation for the development of the sustainable HEV motor. This study comprises total life cycle costs of a HEV motor. The analysis considered capital and operating costs in order to define the total vehicle cost of ownership over 10, 15, and 20 year life expectancies. The development of an integrated life cycle costing and life cycle analysis will allow any individual to evaluate properly tradeoffs of a hybrid-electric vehicle. References: BAILEY, G., MANCHERI, N. & VAN ACKER, K. 2017 Sustainability of Permanent Rare Earth Magnet Motors in (H)EV Industry. Journal of Sustainable Metallurgy, 3, 611-626

WE261 Developing a National Food Inventory to estimate the Carbon Footprint of the diet of Average Spanish, Future requirements and policy recommendations L. Batlle-Bayer, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; A. Bal, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change, Escola Superior de Comerç Internacional ESCI; F. Fullana, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; R. Alidaro, Universidad de Cantabria / Department of Chemical and Biomolecular Engineering Dietary patterns have a significant impact on greenhouse gases (GHGs), and dietary patterns have a significant impact on greenhouse gases (GHGs), and diet choices can increase or reduce the Carbon Footprint (CFP) of consumers. Recently, more research has focused on estimating and comparing the CFP of different diets; however, high uncertainty is caused by the lack of reliable, available or representative data. The current study discusses this issue on data availability, and it results from our previous study on the CFP of the annual food consumption of an average Spanish citizen. To calculate the CFP of the average Spanish dietary pattern, a list of food categories with its representative food products was analyzed quantitatively. The aim is to identify bottlenecks for such a quantitative analysis as well as to identify the hotspots from both an environmental and economic point of view. Furthermore, the results will serve as one of the important inputs in laying the foundation for the development of the sustainable HEV motor. This study comprises total life cycle costs of a HEV motor. The analysis considered capital and operating costs in order to define the total vehicle cost of ownership over 10, 15, and 20 year life expectancies. The development of an integrated life cycle costing and life cycle analysis will allow any individual to evaluate properly tradeoffs of a hybrid-electric vehicle. References: BAILEY, G., MANCHERI, N. & VAN ACKER, K. 2017 Sustainability of Permanent Rare Earth Magnet Motors in (H)EV Industry. Journal of Sustainable Metallurgy, 3, 611-626

WE262 Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars P. Girardi, P.C. Brambilla, RSE Spa / SFE

The scope of this study is to compare the externalities of electric, gasoline and diesel motorisations of an average passenger car (aVW Golf) giving a complementary reading of the results of an LCA. Starting from the results of the NEEDS project, authors present a methodology taking into account: the year of the vehicle, the geographical area where the vehicle takes place; the average level of income of the country in which the emission take place. A complete LCA of an electric, gasoline and petrol VW Golf has been carried out considering city cycle real consumptions from EPA (fueleconomy.gov) and real emissions from national inventories on transport air emission factors (http://www.sinanet.ispambiente.it/it/sia-isra/fetransgo). The use phase of the vehicles occurs in Italy, the energy used for battery charging is the Italian marginal mix, the vehicle assemblies occur in Germany while batteries are assembled in Indonesia. The upstream of fossil fuel is consistent with the nowadays actual national import mix. Emissions of PM10, PM2.5, NOX, SOX, NH3, NMVOC, CO2e have been taken into account for externalities evaluations. Considering that there are numerous processes involved, for each LCA phase accounting for more than 8% of the weighted emission of PM10, PM2.5, NOX, SOX, NH3, NMVOC, a specific height of realise and geographical area have been assinged distinguished by: Italy (wher cars are used and most of electricity produced), Germany (where are cars produced), Austria (where battery are assembled) Lybia, Algeria, Holland, Russia (used upstream of fossil fuel), Japan (as electric car market leader), the rest of the world (for materials production). The damage factor used in NEEDS project have been modified taking into account the real per capita income growth rate from year 2000 to 2015 instead of the foreseen rate and the per capita GDP of considered countries. Moreover, the damage factor of PM 2.5 have been divided in three different damage factors taking into account the different population density of urban, suburban and rural areas. The external costs evaluation for the analysed vehicles shows that Electric Golf performs better in terms of external costs, mainly thanks to the minor costs due to Climate Change. As regard regional externalities, the external costs due to emissions in Italy make the electric vehicle even more competitive than considering the overall regional externalities.

WE263 Life Cycle Costing: methodological description and implementation B. De Caevel, J. Dulbecco, RDC Environment; A. Ciroth, GreenDelta; T. Huppertz, I. Descos, RDC Environment; J. Garcia, SCORE LCA

The complexity of production processes and products combined with an increasing dynamic complexity of environment has created the need to monitor and analyze not only the production phase, but also all upstream and downstream costs. Thus, producers are seeking to minimize the overall cost of their product generated throughout the life cycle. The private consumer, on the other hand, seeks to compare the different investment or purchase options by trying to integrate, in a holistic way, their present costs (acquisition prices and associated taxes) and future costs (use throughout of fossil based LCA) in an overall Life Cycle Costing (LCC) is the typical tool to meet these objectives as it allows to analyze the cost structure of a specific object throughout its life cycle. Due to their convergent approach over life cycle, there are some complementarities between LCC and Life Cycle Assessment (LCA). A combined application of the two approaches could help economic actors and decision makers to find cost-effective solutions, while minimizing their environmental impacts. The environmental impacts, in their turn, can be monetized by taking into account the overall regional externalities. In this way, to be able to aggregate them with the economic costs. Responding to SCORE LCA’s enquiring about LCC and its complementarity with LCA, the purpose of this study is to provide the keys to understanding LCC, its concepts, its scope of use and its theoretical and conceptual limits. It also presents operational implementation elements such as: current methods of applying the LCC, means available for its implementation and possibilities of coupling it with LCA. In a first part, we present the theoretical bases and the state of LCC practice, i.e. definition and history, usefulness and reasons why the method is still not widely used. The second part presents the different types of LCC and the cost perimeters considered for each of them. The third part presents how to implement LCC, with detailed recommendations and examples. The fourth part presents the possibilities of coupling LCC and LCA in practice by first showing the usefulness of such a combination, then by presenting the software that allows coupling methods. We conclude by identifying the necessary work to improve the practice of LCC and LCA coupled with LCA.

WE264 Pizza: it is dangerously delicious! K. Styllianou, University of Michigan / School of Public Health / Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; V.L. Fulgoni III, Nutrition Impact, LLC; O. Jolliet, University of Michigan Computational Medicine and Bioinformatics

The saying, we are what we eat, is true! Diets are key for human health, more than 10 million deaths/year worldwide are attributable to dietary risk factors. A challenge food Life Cycle Assessment (LCA) faces is that, nutrition, a dominant impact pathway for health, is often neglected. At the same time, food LCA

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primarily focuses on single ingredient items while a large portion of modern diets is comprised of mixed dishes, a mixture of ingredients, which often remains unexplored. We propose a framework for evaluating mixed dishes in LCA that considers nutritional health impacts and benefits and demonstrates its application on pizza. We develop a marginal nutritional characterization factors (CFs) that cover major food groups and nutrients and allow the assessment of nutritional health effects in LCA. CFs are estimated by coupling age- and gender-adjusted outcome-specific incidence rates with risk ratios and severity factors from the Global Burden of Disease, measuring benefits (+) and impacts (-) in avoided μDALY/g. To evaluate the environmental impacts, we deconstruct pizza into “basic ingredients” using the USDA Standard Reference 28 database with a resolution of 3,200 single- and multi-ingredients that we further deconstruct. Ingredients are then linked to the life cycle inventory (LCI) datasets from the Ecoinvent v3.2, the World Food LCA Database v3.1, and the ESU World food database. We evaluate impacts using Impact World+. Nutritional CFs for food group and nutrient range between -8 (sodium) and 57 (omega-3 from seafood) avoided μDALY/g. Human health scores for pizzas range from -35 avoided μDALY/serving pizza with extra meat to 2 avoided μDALY/serving pizza with no cheese. For the environmental impact assessment, global warming estimates vary from 0.06 (pizza with no cheese) to 0.20 (pizza with extra meat) kg CO2 eq/serving, corresponding to -0.04 and -0.17 avoided μDALY/serving, respectively. When it comes to pizza, environmental emissions further enhance nutritional health impacts. Nutrition can dominate the human health and should be considered in food LCA. We have developed an approach bringing together environmental and nutritional health effects in a common tool. The most precise FU is to compare protein sources based on the content of all food items and diets in LCA. Expanding this approach to various food items could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

WE265
The impact of supplemented amino acids in animal feed - a new Life Cycle Assessment approach using the Protein Quality Index as functional unit for comparing protein sources
A. Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH
Proteins, which are made up of amino acids (AA), are essential for human health. Most of AA can be synthesized by the body but 8 of them are called “Essential Amino Acids” (EAA) because they cannot be produced by human or animal and it is crucial to get them through food or feed intake. AA are also used as supplements in animal feed, providing the option to reduce the protein content of feed. Protein production has a major impact on the environment: it is responsible of ~14.5% of all human caused greenhouse gas emissions further enhance nutritional health impacts. Nutrition can dominate the human health and should be considered in food LCA. We have developed an approach bringing together environmental and nutritional health effects in a common tool. The most precise FU is to compare protein sources based on the content of all food items and diets in LCA. Expanding this approach to various food items could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

WE266
The ISO/DIS 14008 standard: Monetary valuation of environmental impacts and related environmental aspects – Principles, requirements and guidelines
J. Serre, VERI; T. Bachmann, EIFER - European Institute for Energy Research / Urban systems group
Key words: monetary valuation, framework, standard, ISO 14008 The use of monetised environmental impacts and associated substances has substantially increased in the last couple of years. This trend is mirrored since 2016 by efforts at ISO level to develop standards on environmental costs and benefits. This contribution will present the result of the work achieved in ISO/TC 207/SC 1/WG 7, developing ISO 14008 whose current title is “Monetary valuation of environmental impacts and related environmental aspects – Principles, requirements and guidelines”. The work started in February 2016. After five WG meetings, ISO 14008 has reached the Draft International Standard (DIS) stage in fall 2017. Many organizations have experience in assessing environmental aspects and related environmental impacts resulting from their activities in physical units (e.g. tons of CO2 emitted or numbers of disability adjusted life years, DALYs). To further integrate this information into the decision making process, it is useful to give the same level of importance to environmental impacts and also of related environmental aspects. Monetary valuations enable comparisons and trade-offs between different environmental issues. The aim of this standard is to increase the awareness, understanding, comparability and transparency of monetary valuation of environmental impacts and related environmental aspects. To achieve this purpose, standardised and transparent documentation of the methods used to derive monetary values is essential. The multiplicity of monetary values, methods to determine monetary values, and ethical perspectives on money, requires careful consideration and prudent communication. ISO/DIS 14008 provides a framework that includes principles, requirements and guidance for monetary valuation of environmental impacts and related environmental aspects. Many methodological requirements or recommendations are intended for persons assessing monetary values. Following these requirements and recommendations enables good practice. The requirements in the reporting clause assist the user of monetary values in assessing the quality of the monetary valuation study. The presentation will give an overview of the ISO/DIS 14008 document.

WE267
The safe and sustainable loops framework for assessing residual material flows
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The circular economic system was developed to foster an industrial system that is restorative or regenerative by intention and design. An obstacle in the transition to such a system is that restoration of materials by reuse or recycling is subjected to safety legislation with an origin in the linear economy. In order to combat this obstacle, a shift is required from a purely safety based assessment to a more holistic assessment focused on sustainable development. Such a holistic assessment would be able to assess the absolute safety assessment, a requirement by law, with an assessment of the relative benefit that reuse of material flows have on all aspects of sustainability. However, assessing all aspects of sustainability is not practical for final decision making or feasible, considering the state of development of the tools, methods and data availability. Assessments of current recycling options are mainly focused on safety risks towards the environment and human health. Here we propose a first step in including environmental impacts or benefits related to closing material loops and increasing material value. This step is part of a bottom up approach to a more holistic methodology. It holds a novel framework (Safe and Sustainable Loops, SSL) aimed at assessing the safety as well as the sustainability changes of residual material flows within a clearly defined scope. In the Netherlands specific end of waste criteria can be applied to make the use of residual material flows as a resource or waste a commercial option. Based on this, a selection of themes that are important in the choices regarding derogation of residual material flows for new applications. These themes are the building blocks of the framework, the modules. In theory, the framework itself is the backbone that connects these modules together. The current themes which are developed into modules are: Substances of very high concern (SVHCs), Pharmaceutical residues, Pesticides, Pathogens, Antimicrobial resistance, Circularity and Environmental Sustainability. These were selected for the first iteration of the framework because of their relevance for assessing risks and benefits of residual material flows during the past few years. The aim of this approach is to allow a level playing field using a generic framework with modules based on lessons learned from earlier cases.

WE268
Who is being served? Considering the values stakeholders wish to sustain in decision making
S.E. Apitz, SEA Environmental Decisions Ltd If we want our science to be part of the environmental decision process, we need to ensure that with stakeholders about what they value. However the science we generate is relevant to and translated in terms of these values. This requires a consideration of as diverse a range of affected stakeholders as possible. Unengaged subjects, due to a lack of resources, interest, or awareness, may not have their needs and values addressed unless a special effort is made to identify and consider them. One can view the concept of social equity as all values addressed unless a special effort is made to identify and consider them. A framework with modules based on lessons learned from earlier cases.

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framework which links measurable metrics of impact to value terms that resonate with the public, and reflect value statements made by the community. When the trade-offs are considered, it is important to consider the needs, demographics and vulnerabilities of a diverse population. Sustainability and ES concepts can and should be support environmental decision making; the application of threshold criteria ensures strong sustainability in which environmental considerations are not just considered in an overall framework which guides stakeholders to consider the extent to which they prioritize impacts to all (rather than just a narrow sub-set) of their values provides for a balanced public comment process, less subject to single- or narrow-issue lobbying. Identification of the risks and benefits of most interest to stakeholders also can support negotiation and optimization of alternatives under consideration, support collaborative design of more sustainable options and help inform the design of a long-term monitoring plan that addresses community values. The goal should be to envision a sustainable approach from the beginning of a project with collaborative input from a large group of stakeholders, supporting informed, transparent, and balanced decision making that protects services of importance to the community. Tools and approaches, and the path forward, will be discussed.

Salt of the earth - causes, consequences and management of salinization of surface freshwaters, groundwaters and soils (P)

WE269 Effects of long-term exposure to increased salinity in the amphibian skin bacterium Erwinia toletana
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Amphibians constitute the class of vertebrates with the highest proportion of endangered species; chemical contamination being a main factor for its populations and species decline. The skin bacterial community of amphibians may help them to cope with such chemical contamination. If skin bacteria may increase its tolerance to chemicals, then they could be used for bioaugmentation in amphibians to help them cope with contamination. This work aimed at assess if an amphibian skin bacterium could increase its tolerance to NaCl after long-term exposure to low levels of salinity. *Erwinia toletana*, isolated from the skin of *Pelophylax perezi*, was selected as the model species. Clonal populations of this bacterium (5 replicates) were exposed for 46 days to LB medium (Et-LB) or to the effective concentration of NaCl causing 10% of growth inhibition (Et-NC1; 18 g/L). To assess the capacity of recovery from long-term exposure to NaCl, after the 46 d period, Et-NaCl was transferred to LB medium and cultured for a period of 16 d (Et-R). The isolate also continued to be cultured in LB medium for further 16 d. The tolerance of ancestral and evolved populations to NaCl was assessed by exposing them to 6 NaCl concentrations (5, 10, 15, 20, 25 and 35 g/L) plus a control (LB medium). Effects of NaCl on bacteria growth and metabolic mechanisms (as degradation of carbon compounds) was monitored. Genotypic alterations were assessed using a PCR approach (a molecular fecal index method (BOX-PCR). Results of growth shown that long-term exposure to NaCl slightly increased the tolerance of *E. toletana* to this salt, EtC50 for growth were: 22.5 g/L (8.64-36.4) for Et-LB; 30.3 g/L (23.2-37.4) for Et-NaCl, and 26.1 g/L (19.3-32.9) for Et-R. Though, as confidence limits overlapped, tolerance increase was not considered significant. Furthermore, differences in metabolic processes were observed between Et-LB and Et-NaCl, suggesting the use of different carbon sources. This could be associated with the activation of detoxification mechanisms or energetic demanding mechanisms to cope with osmotic stress. Genotypic alterations were not observed, indicating that *E. toletana* increased tolerance to NaCl could be due to membrane plasticity mechanisms to cope with osmotic stress. The tendency shown by *E. toletana* to acquire increased tolerance to low levels of salinity could constitute a promising bioaugmentation tool in amphibian’s skin, aiming the improvement of these organisms tolerance to chemicals.

WE270 Impacts of agriculture brackish effluents in saline ecosystems: when the low salinity cannot be an advantage but an impact
I. Alvez-Raga, J.M. Barreda, J.A. Superina / Superina / Universidad Agrónomica

Increases in salinity, or the total ionic content, of water can be toxic to freshwater species, as can shifts in the balance of major ions (Ca\(^{2+}\), Mg\(^{2+}\), Na\(^+\), K\(^{+}\), SO\(_4^{2-}\), Cl\(^{-}\)), or increases in the Ca\(^{2+}\) and Mg\(^{2+}\) content of water alone (i.e. water hardness), Although anthropogenic salinization of freshwater is increasing, virtually no water quality guidelines (WQG) exist for regulating these individual ions and their mixtures. When a waterbody reaches a concentration of potentially toxic concentrations via effluent, produced waters, and saline run-off from various human activities, e.g. coal mining, oil and gas extraction, the use of Ca- and Mg-based road de-icers, and agriculture. Thus, developing a water hardness based WQG for the protection of aquatic life is warranted. Using Canadian protocols for WQG development, we attempted to derive a WQG for water hardness. Relevant data were collected for up to 20 years; however, current literature offered several challenges and major data gaps that hindered WQG derivation. Moreover, the background variation of water hardness throughout an exemplar regulatory region of interest also did not support WQG development using traditional methods. These challenges and limitations will be discussed in the context of similar regulations from other jurisdictions, the need to consider additional, practical limitations of regulating water hardness, or major ions in general, recommendations for improved data consistency, and potential regulatory options.
WE273
Prioritization of water quality stressors according to their relative impact on ecological quality of rivers using large-scale field data: salinity first?
E. Berger, Senckenberg Gesellschaft / Department Quantitative Landscape Ecology; R. Schäfer, University Koblenz-Landau; P. Haase, A. Sundermann, Senckenberg

The goal of achieving good ecological quality of all European water bodies requires knowledge on how to prioritize stressors and human pressures for management based on their relative impact. A challenge thereby is the frequent co-occurrence of multiple stressors. We applied eco-epidemiological approaches to large scale monitoring data from Saxony, Germany, to investigate the relative contribution of different water quality and land-use gradients to ecological change. Two approaches were applied: First, water quality gradients (e.g. oxygen, conductivity, phosphorus and microplottants) and land-use gradients (e.g. % arable and urban catchment land cover, position of wastewater treatment plants) were used as predictor variables in multiple linear regression analysis and hierarchical partitioning with ecological quality indices based on invertebrates (% EPT, MMI, ASPT, BMWP, GSI, SPEAR %) as response variables. Second, individual taxon response to salinity was compared to different water quality gradients (including also major ions such as potassium, sodium, chloride etc.) were assessed using Threshold Taxa Indicator Analysis (TITAN). The method is based on change point and indicator species analysis and allows the identification of ecological change points that may be used to derive environmental quality criteria. Both regression analysis and TITAN results indicate a high impact of oxygen and salinity, which were assessed as both the third and fourth drivers based on the TITAN method.

WE274
Estimating protective potassium concentrations for freshwater mussels, a taxon of global conservation concern
T. Augspurger, U.S. Fish and Wildlife Service / Ecological Services

Globally, there are about 620 species of freshwater mussels (Family Unionidae), and IUCN lists 28 species as extinct and 106 as endangered or critically endangered. Mussels are among the most sensitive freshwater organisms to toxicity from chloride and potassium, and the environmental relevance of these is increasing with sea level rise and brine discharges. Average potassium concentrations in relatively unpolluted streams of North Carolina (USA) range from 0.2 to 2 mg/L. An industrial effluent with potassium averaging 504 mg/L and proposed for discharge to a stream with endangered mussels necessitated derivation of protective potassium limits (benthic and carbonate standard limits) for a water quality criteria for potassium). From the literature, we compiled potassium 96-h EC50s (with endpoints of lethality or immobilization) for mussels and retained those with > 90% control survival, measured test chemical concentrations, and acceptable test water quality. Five EC50s ranged from 31 to 48 mg/L at a water hardness of 100 mg/L as CaCO3, and we applied the North Carolina guidance of one-tenth of the salinity limit as a derivate acute toxicity. We adjusted the 10 mg/L acute limit to a water hardness of 18 mg/L which is the 5th percentile of the proposed receiving stream (protective most of time because potassium is less toxic as hardness increases). The hardness-adjusted acute water quality guideline of 7 mg/L potassium was recommended as an instantaneous concentration not to be exceeded. Chronic toxicity data for potassium and mussels were available for two studies from 28 to 300-fold. Because mussels can live for decades, we used the 300-d test. The geometric mean of the test NOEC (1 mg/L) and LOEC (7 mg/L) yield a chronic value of 2.6 mg/L potassium which was reasonable with available data.

WE275
LIFE LAGOON REFRESH - Coastal lagoon habitat (1150) and species recovery by restoring the salt gradient increasing fresh water input.
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The northern Venice Lagoon (SCI IT3250031) holds several Annex I-listed habitats of the Habitats Directive, such as the habitat type 1150* (Coastal lagoons). Recent monitoring activities showed that conservation status of the habitat 1150* is improving within SCI IT3250031, but it is still unfavourable in the inner landward areas due to lack of ecological processes, favouring self-regulation processes, between lagoon and mainland. In the past, the project area was occupied by reedbeds in large amounts, now significantly receded due to increasing of lagoon water salinity, caused by historical human activities (e.g. diversion of rivers with reduction of freshwater supply, inlet and channel excavation). With reduction or disappearance of reedbeds, their contribution to ecosystem services, like supporting numerous biological communities and species, are minimised. The LIFE LAGOON REFRESH project, started on Sept 2017, foresees the restoration of favourable conservation status of habitat 1150* in the northern Venice Lagoon and the recreation of favourable habitats for faunal species of community interest. The project actions involve: diversion of a freshwater flow from the Sile river into the lagoon (necessary for the recreation of the typical salt gradient of buffer areas between lagoon and mainland); restoration of intertidal morphology through the implementation of structures properly arranged to slow down the freshwater dispersion and to favour reed development; planting of Phragmites australis to accelerate the development of the reedbeds; transplantation of small dumps of seagrass species of the habitat 1150*, suitable to accelerate the recolonization by aquatic plants of low-salinity environments. The project aims to exploit the spatially diluted effluents and synthetic solutions (e.g., NaCl/CaCl2) of systems to: counteract the depletion of lagoon bottom and fish communities; reduce eutrophication through reedbed phytoremediation function, favouring the presence of sensitive species and high ecological value aquatic plants; improve conservation status of bird species, including those listed in Annex I of the Birds Directive; increase the presence of fish species, listed in Annex II of the Habitats Directive. The restoration of salinity gradients will also contribute to increase biodiversity on the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE276
Comparing the growth of fescue and clover plants in petroleum industrial effluents and solutions of similar salinity
S. Srikhumsuk, University of Strathclyde / Department of Civil & Environmental Engineering; C. Knapp, J. Renshaw, University of Strathclyde / Civil and Environmental Engineering

Effluents (produced and flow-backs) from the petroleum industry have been between faulted and toxic to the environment, particularly in regards to chemical composition and salinity. The purpose of this study was to investigate whether their toxicity is any greater than exposure to solutions of similar salinities. The tolerance of Festuca rubra L. (fescue) and Trifolium pratense L. (clover) were investigated for 8 weeks under hydronic conditions to compare their growth in brine effluents from tertiary recovery operations. Experiments further compared serially-diluted effluents and synthetic solutions (e.g., NaCl/CaCl2) of similar salinities. There were different growth responses to the wastewater and saline solution among both plant species. F. rubra was exhibited a significant higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and lethality. Interestingly, biomass of both plants were greater from industrial wastewater than the comparable brine solution. Although the restoration of tidal and freshwater conditions will contain abundant inorganic and organic substances that may have triggered plant survival and salt-tolerance, F. rubra grew under salts stress, and presented a mechanism to crystalize salt on their leaves. Hence, plant uptake, under certain conditions, may be promoted as an alternative treatment for high salt concentrations.

WE277
Contribution to the salinization risk assessment, under drought conditions, in the Alqueva irrigation area (South Portugal)
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In Mediterranean regions, climate changes have enlarged water limitation for crops, leading to an increased demand for irrigation water. During the hydrological years of 2016/2017, Portugal presented an extreme drought throughout almost the entire mainland territory reaching a severe drought level. Under water scarcity conditions and high atmosphere evaporative demand, the risk of land salinization is one of the major threats to the sustainability of irrigated agriculture. Therefore, it is very important to assess the quality of irrigation water and the risks of salinity for crop production, in order to adopt appropriate management practices in irrigated areas. This study is focused on the salinity risks for the production of the most representative crops grown in the Alqueva irrigation area. This is a large irrigation scheme with a total area of 120 000 ha centered in the Alqueva reservoir. For the purpose of the study, a chemical assessment of some
major inorganic ions (Na⁺, Ca²⁺, Mg²⁺, K⁺, SO₄²⁻ and Cl⁻), pH and electric conductivity (ECₑₐₚₐ), was conducted throughout 2017, on water samples collected on four platforms sited in the reservoir. Water quality for irrigation was evaluated considering both the Portuguese regulations and the FAO guidelines. Sodium adsorption ratio (SAR) and soil salinity (ECₑₐₚₐ) were estimated, in order to assess potential sodium-related soil permeability and crusting problems, as well as, potential yield reductions in the most significant crops of the Alqueva perimiter. Higher ion concentration related with lower salinity and lower ECₑₐₚₐ selected water salinity. We selected water samples from 24h, 48h, 72h, 96h, 114h, 156h, 300h, 600h, 1200h, 1800h, 2400h, 3600h, 4800h and 6000h.

The presented methodology can serve as an example for the study of other species related with toxicant mode of action and stress situation. We hope that the obtained information for these experiments are presented, showing the interest of designing ecological interest of this approach, individuals were treated with an antibiotic, six genes used as reference to design an array for Real-time PCR. Comparison with database allowed the identification of genes involved in toxicity tests because of its sensitivity to different toxicants and ease of culture. Invertebrates are genome models for soil toxicology studies and it has been proposed as an adequate species for toxicity tests because of its sensitivity to different toxicants and ease of culture. Systems ecotoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (P)

WE279 Investigating wildlife diets using high-tech DNA sequencing
J. Ludwig, Rifcon GmbH; I. Katzschner, Rifcon GmbH Goldbeckstr Hirschberg Germany, G. Weyman, ADAMA; A. Winkler, J. Kalinowski, Center for Biotechnology (CeBiTec) Universität Bielefeld
In wildlife risk assessments according to EUSPA (2009), the ingested diet is one of the core factors to define exposure, using different diet composition in the first tier risk assessments. The compiled PD factor (composition and portions of diet) is one of the standard refinement parameters which intend to add realism to higher tier risk assessments. Publicly available dietary data are often used to refine PD in wildlife risk assessments; however, such data are often variable and/or not representative for the specific risk assessment scenario. Besides such literature data, specifically registration-relevant PD field studies can be conducted. PD values gathered from such studies are based on diet compositions of prey samples, or faeces. In these studies samples (or parts thereof), are investigated visually by microscope and food items are identified based on comparison with comprehensive reference data libraries and collections of potential diet items. For plant material, the results are mainly presented on a relatively small taxonomic level and are often related to the relative risk assessment defined diet fractions which have different default residue levels (different types of plants or monocultures vs. polycultures only). However, this is rather time-consuming and imprecise. Recently, RNA sequencing techniques are increasingly applied for diet composition analyses in ecological science. We initiated an approach using ‘next-generation’ DNA amplicon sequencing to quantitatively assess the diet composition of wild herbivorous mammals, taken from faeces samples collected on arable fields. Data on the relative abundance of each plant species were derived by enrichment and sequencing of a specific DNA region (ITS2 region of the ribosomal DNA) and by comparison to comprehensive plant species DNA databases. The approach has proved to be very useful in identification of relative abundances of plant species from faecal samples. This new approach, its needs and limitations for refined risk assessment will be presented and discussed.

WE280 Design of a Real-Time PCR array to analyze the gene expression in Physella acuta (Gastropoda) in chemical stress and starvation
M. Novo, J. Martínez-Guirarte, UNED / Fisica Matematica y de Fluidos Molecular endpoints are currently used under well-defined conditions in toxicity tests. While vertebrate species are usually well-known, there is a lack of information on invertebrates. The study of the latter is complex since their body plan is different from mammalian species. To address this, new methods for the identification of molecular endpoints and to evaluate some genes as biomarkers, a Real-Time PCR array has been designed for Physella acuta. This species of freshwater snail is used in environmental toxicology studies and it has been proposed as an adequate species for toxicity tests because of its sensitivity to different toxicants and ease of culture. A transcriptome for this species was assembled, by sequencing cDNA libraries from individuals of different developmental stages and exposed to different toxicants. Comparison with database allowed the identification of genes involved in pathways related with toxicants selected (e.g. selected 42 of these genes as reference to design an array for Real-Time PCR analysis. Stress response, detoxification mechanisms, endocrine system, or epigenetics were some of the pathways analyzed in the array. In order to validate the toxicological and ecological interest of this approach, individuals were treated with an antibiotic, tetracycline, for seven days or were left starving for 7 and 10 days. The results obtained for these experiments are presented, showing the interest of obtaining specific arrays to perform more detailed analysis of molecular endpoints that can be related with toxicant mode of action and stress situation. We hope that the methodology presented here can serve as an example for the study of other species in order to improve our knowledge of their biology. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), CTM2015-64913-R.

WE281 Effects of temperature on the transcriptome of the marine copepod Temora longicornis
J. Semmouri, Ghent University (UGent) / Animal Sciences and Aquatic Ecology; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology; R. Janssen, Ghent University / Applied Ecology and Environmental Biology; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology
Over the past decades, the world's oceans and seas have been influenced by several human induced impacts, including climate change. In the North Sea region, the average sea surface temperature of the water has already risen with 1.2 °C over a time span of twenty-five years and is likely to rise further. Understanding the impacts of this changing environmental condition in zooplankton communities is crucial, as alterations in the zooplankton communities can affect entire marine ecosystems. Here, we focus on the potential effects of an increase in temperature on the calanoid copepod species, Temora longicornis, the dominant zooplankton species of the southern part of the North Sea. Since responses to environmental stress are genome-driven, a genetic study on the physiological responses to thermal stress can provide an increased mechanistic understanding and help predict potential responses to climate change in this copepod species. Therefore, we sequenced the whole transcriptome (using RNA-sequencing technology) in T. longicornis, after being exposed to thermal stress, to investigate gene expression differences as a response to temperature fluctuations. As such, this dataset will provide a baseline for understanding the effects of increased sea water temperatures may affect the fitness of the most dominant zooplankton species of the southern part of the North Sea.

WE282 A conditional approach to modern endpoints - quantitative assessment of stress gene expression response to a range of copper concentrations in the freshwater mussel Anodonta anatina
G.M. Ekulend Uge, Lund University / Biology; A. Jonsson, University of Skövde / Department of Bioscience; O. Berglund, Lund University / Dept of Biology
In the field of ecotoxicology, modern transcriptomics technologies have the potential to improve and complement current toxicity assessment methods and biomonitoring protocols. Early warnings of general stress and specific toxic modes of action could in theory be used as biomarkers of pollutant exposure or adverse effects. However, necessary base level understanding is currently lacking considering how gene expression may vary under realistic exposure scenarios. Therefore, we adopted an approach of quantitative assessment as an alternative to more descriptive methods. We chose the freshwater mussel Anodonta anatina as our model organism. Being a stationary filter feeder, it shows promise for use in exposure studies under both laboratory and field conditions. Furthermore, it is the most abundant freshwater mussel species in Sweden, and occurs in freshwater ecosystems over most of Europe. For the present study, mussels were collected locally in Vinne å (southern Sweden), on a location free from point source pollution. After two weeks of acclimatization to laboratory conditions, mussels were exposed for 96 h to one of three copper treatments (nominal concentrations of 1, 10 and 100 µg Cu²⁺ per litre), or a control treatment (n= 5 per treatment). Using RT-qPCR, relative expression of a selection of general stress genes will be quantified in extracted digestive gland and gill tissue. Preliminary data will be presented, testing the hypotheses that the amplitude (fold-change) of relative expression differs (i) between the different copper treatments, and (ii) between the different copper treatments. Results from this initial experiment will be used to design a follow-up experiment, in order to test the dose-dependence of gene expression responses. Gradually, successively increased exposure scenario complexity (e.g. duration, chemical composition) will help us to better understand how expression patterns potentially vary under environmental exposure. By subsequent incorporation of biochemical and physiological biomarkers, we also aim to link stress gene expression patterns to effects at higher biological levels. Ultimately, a more thorough understanding of natural and pollution-induced variation in gene expression may allow transcriptomics to be usefully and successfully incorporated into various ecotoxicological assessment protocols.

WE283 Validating a contamination assessment tool from lab to the field: Folsomia candida exposed to a fungicide-based formulation
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Folsomia candida is a widespread arthropod that occurs in soils throughout the world and has been used as a standard test organism in past decades for estimating the effects of pesticides and environmental pollutants on non-target soil arthropods. This species is among the most sensitive representatives of its taxon, being selected as a genomic model organism for soil toxicology studies. Although laboratory
experiments with a transcriptomics approach are essential to unravel modes of action of chemical compounds, higher-tier studies (e.g., field studies) are crucial as a validation criterion in environmental risk assessment trials, while their ecological relevance is increased when complemented by pertinent information at lower-tier studies (molecular level). Therefore, the main goal of the present study was to validate the mode of action of a commercial fungicide formulation in *F. candida* under a real-relevant field exposure scenario, by targeting specific molecular biomarkers retrieved from a previous laboratory study on previous time-course data of survival and reproduction effects in *F. candida* exposed to a commercial formulation of the fungicide chlorothalonil (40% Bravo®500) in a natural agricultural soil under laboratory conditions, organisms were now exposed under field conditions for 4 days to the same concentration as for laboratory exposure (causing a 75% reduction on reproduction) and the Predicted Environmental Concentration (5 mg a.i./Kg). Invertebrates were previously cultured in laboratory and simultaneously 12 replicate soil cores per treatment (including control) were collected from the field and defaunated. The cores were placed back in the field and 220 organisms (10-12 days old) were added per replicate core. Field contamination was made by spraying after a 3 hours acclimation period to the field by the organisms. RNA was extracted from each pool of organisms using the TRIZOL® methodology. According to previous laboratory “omics” results with the same set of specific genes were selected for a targeted gene expression analysis by qRT-PCR, corresponding to key genes of affected biological pathways including glutathione metabolism, oxidation-reduction, body morphogenesis and reproduction. This work contributes with a set of molecular biomarkers which can be used to develop a more effective set of tools to assess the early effects of such fungicide formulations in a real scenario of soil contamination.

WE284

Proteome response of Chironomus riparius under exposure to the neurotoxic insecticides Spinosad and Indoxacarb

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The development of quantitative methodologies in proteomics opened new doors for their potential applications within environmental sciences. Since proteins are the functional units of cells, the proteome of an organism at a given time and at a given condition reflects its current state. In this sense, any protein profile changes in response to toxicants may reveal their molecular targets and/or specific stress-response mechanisms, and thus can be used as potential early warning biomarkers of toxic exposure. In this study, the potential of proteome changes as an early warning indicator for pesticide exposure in *Chironomus riparius* (Meigen) was evaluated using as model compounds two neurotoxic pesticides with distinct modes of action, spinosad and indoxacarb. *Chironomus riparius* third-instar larvae were exposed to three concentrations of each pesticide and iTRAQ methodology was performed to relatively quantify protein expression changes between exposed and control groups. Several proteins were identified with different responses at the proteome level. Changes caused by spinosad were more noticeable than for indoxacarb exposure. Our results revealed a general decrease in the expression of globin proteins with the increase of spinosad concentration. Additionally, for spinosad, a significant decrease in the expression of an actin and a cuticle protein were also observed. Moreover, correlations between proteomics data and the effects on the chemical biomarker and the aquatic toxicity tests in both pesticides. Our results suggest that protein profile changes have the potential to be used as early warning biomarkers of pesticide exposure, providing an interpretation of molecular pathways of toxicity behind the organismal response, therefore supporting the risk assessment of pollutants. This work contributes to the growing interest in the discovery of new early warning indicator for pesticide exposure in aquatic organisms, offering additional insights for their potential applications within environmental sciences. Si

WE285

Assessing Cu impacts on freshwater diatoms: biochemical and metabolomic analysis by qRT-PCR, corresponding to key genes of affected biological pathways including glutathione metabolism, oxidation-reduction, body morphogenesis and reproduction. This work contributes with a set of molecular biomarkers which can be used to develop a more effective set of tools to assess the early effects of such fungicide formulations in a real scenario of soil contamination.

Assessing Cu impacts on freshwater diatoms: biochemical and metabolomic responses of Tabellaria flocculosa (Roth) Kützing

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Metals are a recognised threat to aquatic organisms but the impact of metals such as copper (Cu) on benthic freshwater diatoms is poorly understood, even if diatoms are commonly used as water quality indicators. Our study aimed to elucidate the cellular responses of diatoms to Cu toxicity. The freshwater diatom *Tabellaria flocculosa* (TFL), isolated from a Cu contaminated stream, was exposed to 0.3, 6 and 10 µg Cu/L, and the tolerance level and the cellular targets were studied using biochemical, physiological and metabolomic approaches. Cu was already toxic to *T. flocculosa* at concentrations common in environments which are usually not considered to be contaminated (0.3 µg Cu/L), and toxicity increased with Cu concentration. Strategies to cope with Cu varied with the level of Cu stress. Under Cu impact, the metabolome of *T. flocculosa* changed significantly, especially at high concentrations (6 and 10 µg Cu/L). Cu toxicity was counteracted by increasing extracellular immobilization (EPS, frustulin), antioxidant (SOD, CAT) and detoxifying (GSTs) enzymes activity and low molecular weight antioxidants (GSH). These mechanisms enabled an increased energy production (ETS activity, use of sugars and lipids). At the highest Cu concentration (10 µg/L), these processes were specifically enhanced in an attempt to restrain the oxidative stress generated by high intracellular Cu concentrations. However, these mechanisms were not able to fully protect cells, and damage in membranes and proteins occurred. Moreover, the decrease of hydroxyamine and unsaturated FA and the increase of saturated FA, 2-palmitoyl glycerol, glycine, and diterpenoid compounds should be tested as new specific markers of Cu toxicity in future studies. This information can support the prediction of diatom behaviour in different Cu contamination levels, including highly impacted environments, such as mining scenarios, and may assist in environmental risk assessment policies.

WE287

Non-targeted approach to identify metallochemical perturbations in gilt-head bream liver and brain exposed to benzophenone-3

H. Ziarrusta, L. Mijangos, Universidade de Aveiro / UP/HEU / Department of Analytical Chemistry; S. Picar, A. Perera, Polytechnic university of Cartagena / UP/ CESAI and control tanks, to control the course of the experiment. M. Olivaros, O. Zuloaga, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UP/HEU) & Dep Analytical Chemistry

Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation. The extensive use of BP-3 has led to its ubiquitous occurrence in the aquatic environment, causing an ecotoxicological risk to biota. Although some studies reported adverse effects at both mussel and fish, further research is needed to do in order to assess its molecular and physiological effects, and modes of action. Therefore, in the present work, we investigated metallochemical perturbations in juvenile gilt-head bream *Sparus aurata* exposed over 14 days via the water to BP-3 (50 mg/L). Liver and brain were collected prior to dosing and on exposure days 2, 4, 7 and 14 from control (n=10) and exposed (n=10) animals. Samples were flash frozen and then stored at -80°C until analysis. Methanol:chloroform (80:20, v/v) mixture was used for non-selective extraction of fish tissues and subsequent non-target analysis was performed by means of UHPLC-Orbitrap MS in positive and negative modes with both C18 and HILIC separation. Metabolites were identified using Compound Discoverer (Thermo) interfaced to MZmine and the statistical data treatment was carried out with R software. Mortality was not observed during the experiment, and no statistical changes in fish weight, fish length, condition factor and hepatic somatic index were observed regardless of tank or dosing period. First of all, using sequence quality control samples, data had to be corrected to remove the effect of injection order. On the other hand, since some metabolites were significantly altered in both exposed and control group (exposed or control). Metabolites driving group separation were further investigated using the Kyoto Encyclopedia for Genes and Genomes (KEGG) in order to determine affected pathways. Overall, these data demonstrate the potential of metabolomics as a powerful tool for the early warning of environmental contaminants. Keywords: Benzophenone-3, gilt-head bream, non-target metallochemical Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. H. Ziarrusta is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.

WE288

EFFluENTS FROM PULP AND PAPER MILLS PROMOTE METABOLIC ALTERATIONS IN LIVER AND GONADS OF FISH

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Effluents from pulp and paper mills are internationally recognized as containing toxic substances with properties to alter the reproductive capacity of fish. The objective of this study was to evaluate the metabolic modifications (using metabolomics tools) of fish gonads and liver (Danio rerio) exposed to effluents from the pulp and paper industry before and after the employment of embryos of the respective fish. The effluent was diluted by a factor of 1/25. The fish (10 males and females) were exposed to the effluent, and males and females were kept separated for 7 days at 28 °C and a light / dark cycle of 12/12 h in 3.5 L tanks. After the pre-exposure period, males and females were mated (1 couple per Becker containing a net at the bottom) and monitored for 6 days with daily water/pollutant renewal and once a day. The eggs were collected and placed on plates containing the test agent, kept protected from light. The fish were sacrificed for liver and gonads removal, from which a homogenate was prepared. Then, extraction was performed with chloroform/ methanol/water (3: 2: 1). The extract
obtained was prepared for gas chromatography. For the exposed fish, there was a significant reduction in egg production, 65%. A high percentage of the eggs presented dark staining, which are not viable. Chromatography analysis revealed significant changes in the amino acid, sterol and fatty acid profile in both tissues, liver and gonads. The results showed a strong impact on the metabolism, egg production and embryo development for the studied fish, which point to the alteration of their reproductive capacity.

**WE289 Developing biomarkers of sewage effluent exposure in the freshwater amphipod Gammarus fossarum**

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Pesticides, pharmaceuticals, industrial chemicals and complexing agents coming from sewage effluents, can be detected in the aquatic environment in very low concentrations. They are able to impact ecological communities, causing biological alterations in many species. Although biomarkers in vertebrates have long been applied, attempts to monitor dysfunctions in invertebrates using orthologous genes have produced inconsistent results. Gammarids are a group of amphipods that have been shown as very sensitive to pollution, having been used in various studies for toxicity evaluation of river waters through exposure to many different chemicals. However, to date most studies have been focusing on specific life-cycle stages, potentially missing complex interactions among expressed genes not involved in development. The aim of this study is to provide a set of new transcriptomic and metabolomic markers in *Gammarus fossarum*. After validations in further studies, the new biomarkers found in this project could be used to evaluate the state of aquatic ecological niches and the efficiency of wastewater treatment plants (WWTPs). Amphipods were sampled from a freshwater stream located in Elgg, Switzerland in September 2017, using standard kick-net method. This stream flows through an industrial WWTP, steadily exposing the whole fauna and flora to a range of pollutants. Sampling was performed 50 m downstream of the WWTP and 50 m upstream, as reference site. Five biological replicates and five technical replicates for both males and females, sampled upstream and downstream were used to get 20 samples containing total RNA. A subsample of amphipods was collected for metabolomic analysis and additional samples were fixed to record population markers, such as sex ratio, fecundity rate and potential intersexuality phenotypes. The RNA samples have been sequenced by Illumina Genome Analyzer. A differential expression analysis will be conducted to identify significantly different genes between upstream and downstream populations. Subsequently, a comparison between amphipods and metallobiomarkers will be carried out, leading to an understanding of the biological functions impaired after amphipods wastewater exposure. A biological pathway analysis will be also performed on the differentially expressed genes, allowing a correlation of the impaired molecular pathways after chronic exposure to water pollutants with the chemical mixture found in the wastewater effluent.

**WE290 Optimising the algal toxicity test towards generation of multi-omics data and adverse outcome pathway discovery**

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The adverse outcome pathway (AOP) concept represents a framework to organize mechanistic understanding of toxicological interactions by causally linking critical molecular key events (KE) to apical endpoints relevant for chemical risk assessment. Currently, only few methodologies can be considered for an accurate and reliable discovery and quantification of KEs in an exhaustive approach, commonly requiring sustained research effort. In this context, the objective of our presented proof-of-concept study was to showcase the identification and characterisation of molecular KEs from the molecular stress response of *Chlamydomonas reinhardtii* by applying a multi-omics high-throughput genome-scale wide multi-omics (metabolomics, lipidomics and transcriptomics) technologies. The approach towards achieving this end was a suite of untargeted (direct-infusion mass-spec, DIMS; RNA sequencing) and targeted (LC-MS/MS, -UV, -qRT-PCR) technologies. This methodology enabled us to profile the concentration- and time-response profiles of molecular signatures from algae exposed to non-specific mechanism (baseline toxicity) and target-specific mechanism (carotenoid biosynthesis inhibition) toxicants. To enable this work, a rigorously controlled algal culturing and testing system was optimised regarding growth rate, final cell density, pH stability, cell cycle synchronisation, reproducible exposure to volatile chemicals, and rapid quenching and harvesting of biomass for omics data collection. Furthermore, a unique multi-phase experimental design was developed for rapid identification (untargeted), characterisation and verification (targeted) of putative KEs over a time-course design. Multi-omics dataset from toxican-exposed *C. reinhardtii* were collected and initial progress made towards computational analysis, putative KE designation, and targeted verification of identified biomarkers. With this study, a powerful experimental approach for hypothesis-free KE discovery and AOP hypothesis is being developed, employing omics-driven algal phenotyping to advance the integration of omics data into AOP development and ultimately, to provide mechanism-based support for regulatory decision-making in environmental risk assessment.

**WE291 Elucidating interactive toxic effects of copper and lead on marine mussels: molecular to physiological consequences**

C. Crowther, V. Sharma, Plymouth University; A. Turner, Plymouth University / Food Safety; A.N. Jha, Plymouth University / Biological Sciences

It is increasingly recognised that anthropogenic contaminants are not isolated in their threats to the aquatic environment. Recently there has been a shift towards measuring the effects of exposure to low-concentrations chemical mixtures under chronic conditions to predict outcomes on the ecosystem. Adopting an integrated approach the aim of this study was to assess the interactive effects of copper (Cu) and lead (Pb) either alone or as a mixture at various levels of biological organisation, ranging from molecular to individual levels. The combination of proteomics, molecular and physiological measures with bioinformatics adopted in this study will allow a model of mixture exposures to be created which can be translated to early warning indicators within the marine environment. *Mytilus galloprovincialis* were exposed to a range of concentrations of Cu (5, 32 μg/L) and Pb (5, 25 μg/L) both individually and in a binary mixture. After a 14 day exposure, a number of physiological and molecular parameters were assessed. This included: measurements of ‘clearance rate’, acetylcholinesterase activity, inductions of micronuclei (MN), DNA strand breaks (i.e. Comet assay) and measurement of protein profile (i.e. proteomics using LC-MS). The clearance rate shows that the mussels exposed to all treatments containing 32 μg/L of Cu have a significantly decreased feeding capability compared to controls, regardless of singular or binary exposure. This was in contrast to the comet assay results which suggests a non-specific relationship between treatments and the highest binary treatment (32, 25 μg/L Cu and Pb, respectively). Mussels exposed to 25 μg/L of lead showed an increase in acetycholinesterase activity, this treatment was significantly higher than both the highest copper binary mixtures. The analysis of protein profile is in process which should provide the potential functional effects of exposures of these two environmentally relevant metals, either alone or in combination. Furthermore, once this study has determined the chemical interactions between binary metals and the mussels’ proteome this could pave the way for further omics being performed and adapted for the ability to create early warning environmental indicators, not only for the environmental health but also for human health.

**WE292 The Identification of Toxological Markers in Adverse Outcome Pathway Discovery in Chlamydomonas reinhardtii**

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Current regulatory toxicity testing methods have become unsuitable for the thorough assessment of chemicals for commercial use, as lack of insight into toxicological mechanism prevents accurate predictive risk assessment. Adverse outcome pathway (AOP) hypothesis for evaluating chemical toxicity is derived from a diverse range of methodologies, including in silico and in vitro approaches, for use in regulatory decision making. The aim of this work was to develop and test a more comprehensive experimental design, for the targeted characterisation of key events in the toxicological response of *Chlamydomonas reinhardtii* upon herbicide exposure, thereby contributing to the development of a quantitative AOP. Here we present how an initial hypothesis for an AOP was created from available literature evidence, with focus on ‘omics and multiple-endpoint assay data, for the selected herbicide, norflurazon. This hypothesised AOP allowed development of targeted assays for investigation of predicted key events in a time- and concentration-response methodology. LC-UV was used to monitor suspected toxological markers in the carotenoid biosynthesis pathway (phytoene, phytofluene, b-carotene). qPCR was used to identify differential mRNA expression of chloroplast-specific threedoxin PRX1, and a lipid peroxidation assay was applied for determining downstream effects of non-specific oxidative stress. A concentration- and time-dependent response in phytoene accumulation was observed, whilst concentration dependent b-carotene depletion was shown at later timepoints. Lipid peroxidation increased to 80% above base line within an hour of exposure, whilst lipid peroxidation occurred between 4 and 24 hours post-exposure. Significant (p < 0.01) effects on cell number, an adverse outcome, were observed at 2000μg/L after 24 hours. This study highlighted the necessity for use of synchronous algal cultures for accurately understanding mechanism, as this would enable more accurate determination of time- and concentration- responses due to diurnal algal life cycles. Ultimately, this work has shown proof-of-concept and laid the foundation for development of a quantitative AOP for phytoene desaturase inhibition leading to growth inhibition and population decline.
WE293
Effects of water-borne benzo[a]pyrene on early-life stages of the fathead minnow (Pimephales promelas)
M.T. Schmitz, RWTH Aachen University; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; N. Busu, McGill University / Faculty of Agricultural and Environmental Sciences; H. Hollett, RWTH Aachen University / Institute for Environmental Research; N. Hogan, University of Saskatchewan / Toxicology Centre and Department of Animal and Poultry Science, College of Agriculture and Bioresources; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

WE294
SETAC OMICS Interest Group
B. Campos, Unilever R&D / Environmental Chemistry

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (P)
WE296
Epigenetic effects in Daphnia magna by characterizing quantified abundance of global methylation, gene expression and histone modifications
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Daphnia magna is used in toxicology and environmental science as a monitor for ecosystem health. Epigenetic analysis is enabled by the genome of the closely related D. pulex. Epigenetic mechanisms allow gene regulation in a developmental and ecological context and in response to environmental stimuli. The best studied epigenetic mechanisms are methylation forms on cytosines in a CpG context and post-translational modifications (PTMs) on histone proteins attached to DNA. The global abundance or change of 5-methyl-cytosine (5mC) may indicate epigenetic reactions to environmental stimuli, since these methylation forms facilitate in the regulation of gene expression the change in expression can be detected and compared. The elucidating histone PTM code give insight on how these proteins modifications regulate gene expression and crosstalk with each other and with DNA methylation. Chromatin immunoprecipitation (ChIP) is the standard assay of choice for analyzing the genomic localization of histone modifications. Exposure to the well-known epigenetic modulator, the DNA methylation inhibiting agent 5-Azacytidine, resulted in a global reduction of DNA methylation in Daphnia magna in one generation, while H3K4me3 and H3K27me3 remains unchanged on the investigated loci. The unchanged response in ChIP was contradictory to significant gene expression responses and to what was expected of this epigenetic modulator. The present study therefore demonstrates differentiated response of LC-MS/MS, ChIP-PCR and gene expression to 5-Azacytidine exposure when characterizing epigenetic stress response in D. magna.

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WE297
Role of microRNAs in the response of the European eel Anguilla anguilla to water pollution
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WE298
Exposure to copper during embryogenesis caused temporary increased tolerance in two subsequent generations in the three-spined stickleback (Gasterosteus aculeatus)
L.V. Laing, University of Exeter / Biological Sciences; H. Littler, J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; N. Bury, Kings College London; R. van Aarle, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; R. Wilson, University of Exeter / Biosciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences

Exposure to copper during embryogenesis caused temporary increased tolerance in two subsequent generations in the three-spined stickleback (Gasterosteus aculeatus). This study builds on the work of Zanella et al. (2018) who demonstrated that the multigenerational tolerant phenotype observed was caused by paternal SD, while the offspring showed maternal SD. The current study was conducted to test the hypothesis that copper tolerance, as an SD, is heritable and that the trait is linked to copper handling. We conducted a study in which stickleback were exposed to copper during embryogenesis and were reared as juveniles and adults to assess changes in copper handling. We found that fish exposed to copper during embryogenesis were significantly more tolerant than control fish. We also found that the offspring of fish exposed to copper during embryogenesis showed increased copper handling compared to control fish. These findings suggest that copper exposure during embryogenesis can cause changes in copper handling that are passed on to subsequent generations, indicating a potential for transgenerational effects in copper exposure. This study provides evidence for the potential for transgenerational effects in copper exposure, which could have implications for the management of copper contamination in freshwater systems. Further studies are needed to investigate the mechanisms underlying these transgenerational effects and to assess the potential for long-term impacts on fish populations.
tilapia? J. Kuo, Kaohsiung Medical University; L. Li, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung

**Abstract**

Nanomaterial technology was well developed in recent years, and it lead to the nanomaterials accumulation in the aquatic organism. Otherwise, increased atmospheric carbon dioxide causing the phenomenon of global warming. However, less is known about the effects of warming whether increase the bioaccumulation of copper nanoparticles in freshwater fish. The purpose of this study is to assess whether warming synergistically increase the bioaccumulation of copper nanoparticles in tilapia (*Oreochromis niloticus*). Tilapia were randomly exposure to 25 nm of copper nanoparticle (0.3 mg/L) under different temperature (26, 28 and 30°C) for periods of 7 days for uptake and 7 days for depuration, to analyze the accumulation of copper in muscle on fish. Result showed that the copper accumulation of muscle in the high temperature group was higher than that of control group on day 7 of uptake phase, but there were not significant difference. For one day of depuration phase, the copper accumulation of the 30°C group was significantly higher than of 26 and 28°C groups (p<0.01). However, they are similar accumulation concentration in the end of depuration period. This study concluded that warming global warming could increase bioaccumulation of copper nanoparticle in tilapia.

**WE300**

**Environmental mixtures of nanomaterials and chemicals: proposal for a consistent nomenclature of mixture effects in environmental organisms**

V. Hammers, W. Classen, M. Weisse, T. Strauss - Institute for Environmental Research / Bioanalytical Ecotoxicology; R. Altenburger, UEF Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Naasz, UFZ Helmholtz Center for Environmental Research / Bioanalytical Ecotoxicology.

A review of the existing literature on mixture effects of nanomaterials (NM) and chemicals in environmental organisms was conducted in order to evaluate the current state of knowledge. More than 120 studies were assessed to explore the relationship between changes in contaminant and NM uptake, bioconcentration, and toxicity. The specific aim of the review was to describe more specifically the interactions that have been observed and to classify the most common mechanisms. As the literature evaluation demonstrated, the existing evidence for interference of NM-chemical mixture exposure with uptake and toxicity is rather diverse. Based on the observations made, we could discriminate at least 7 different categories to capture the evidence ranging from no changes in uptake and toxicity to an increase in uptake and toxicity upon mixture exposure to chemicals and NM: (1) increase in accumulation and toxicity (2) increase in accumulation and no change in toxicity (3) increase in accumulation and decrease in toxicity (4) no change in accumulation and toxicity (5) no change in accumulation and decrease in toxicity (6) decrease in accumulation and increase in toxicity

However, we assume that these observations were caused by different underlying mechanisms and processes, hence we developed a process oriented, tiered approach considering (1) Adsorption / Interaction between NM and chemicals, (2) Uptake of NM by organisms, (3) Desorption of chemical inside / outside the organism, and (4) Toxicity. By sorting the mixture datasets from the studies according to these processes, 6 groups were built. Based on these 6 groups, a consistent nomenclature is proposed: (1) Trojan-horse (+) (2) Trojan-horse (-) (3) Surface enrichment (4) Retention (5) Inertism (6) Coalism The poster will present in detail the characteristics of the 6 groups and the criteria that were used for the assignment of datasets. All in all, this in-depth analysis of mixture datasets underline the importance of a process oriented approach in the elucidation of specific mixture effects. The tiered approach results in a consistent terminology to unambiguously describe the different mechanisms of mixture effects that may occur in environmental organisms. Acknowledgement - DK was partially funded by the German Federal Ministry for Education and Research (BMBF) in the frame of the DaNa2.0 project (Data and knowledge on nanomaterials), grant no. 03X1313.

**WE301**

**Investigating the Trojan horse effect of nanoparticles on an aquatic community - An outdoor mesocosm study**

T. Strauss, Research Institute gaia; C. Gusen, Research Institute Ecosystem Analysis and Assessment; S. Claassen, Research Institute gaia; T. Knautz, M. Hammers-Wirtz, Research Institute gaia; T. Strauß, Research Institute Ecosystem Analysis and Assessment.

Carbon based manufactured nanomaterials (C-MNMs) are promising materials in nanotechnology. Although both fullerenes and carbon nanotubes have been detected in aquatic organisms, there is a lack of data on their bioaccumulation, potential toxic effects on the food web and the food web impact of anthropogenic pollutants. Most effect studies performed until now dealt with waterborne exposure of single species for short time periods in the laboratory. Here, we present a long-term experiment under environmentally relevant conditions. In particular, the Trojan horse effect has been investigated in this study, in order to obtain more data on the interaction between nanoparticles, other pollutants and biota. In principle, pollutants can become more bioavailable by adsorption to carbon-based nanomaterials. In addition, a spatial transfer of contaminated nanoparticles from the water phase to the sediment could increase the exposure to benthic macroinvertebrates but might also reduce the effect on the planktonic organisms. An outdoor freshwater mesocosm study was conducted with C60 fullerenes and the biocide triclocarban (TCC) using twelve outdoor ponds with a water volume of 3 m³. In addition to uncontaminated controls, both substances were tested alone and in combination. The aim of this mesocosm study is to investigate long-term effects of C60 fullerenes on the community level and to assess their potential to affect the toxicity of TCC. In this outdoor mesocosm study direct and indirect effects on single species as well as on community level endpoints like diversity were evaluated. The taxonomic group of interest were the cladoceran Daphnia, zooplankton (e.g. Daphnia species), and macroinvertebrate species (e.g. chironomids, mayflies, oligochaetes, leeches). Different sampling techniques were used in order to include macroinvertebrates living on and within the sediment as well as hatching insects. In this presentation the results of the mesocosm study will be presented. This work has been supported by the German Federal Ministry of Education and Research (BMBF) as part of the NANO-transfer project.

**WE302**

**Nano silver based products and environmental challenges: toxicity and accumulation in a marine sentinel species**

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The use of nanomaterial-based consumer products is constantly increasing worldwide and their release into the environment is thus expected, especially in aquatic ecosystems, which are considered the ultimate sink. The use of nano silver (AgNP) based products as antimicrobial agents is undergoing a rapid increase in terms of production due to its biocidal properties. Here we studied the impact of AgNP-based commercial products named NanArgen (Nanotek S.A.) on a common marine bivalve sentinel species (the Mediterranean mussel *Mytilus galloprovincialis*) in terms of biological responses and Ag accumulation. Animals were in vitro exposed for 96h to NanArgen product containing 20-40nm AgNP, according to the manufacturer, at two different concentration (1 μg and 10 μg/L) using natural sea water (NSW) as exposure media. Lysosomal membranes stability (NRRT) and micronuclei frequency (MN) were measured in mussel’s hemocytes. Catalase (CAT) and glutathione-s-transferase (GST) activities were measured in digestive gland as well as the content of malondialdehyde (MDA) and metallothioneins (MT). Effect on multi xenobiotic resistance (MXR) phenotype was assessed by measuring efflux ABC transporters also in vitro using mussel’s gills. Total Ag was analyzed in exposure water after 24h and in mussel’s soft tissue after 96h. DLS analysis as well as TEM have been also performed on NanArgen formulation in NSW. A significant increase in lysosomal destabilization and MN frequency was observed in hemocytes of mussels exposed to both concentrations of NanArgen. Furthermore, MT content was significantly higher in digestive gland of mussels exposed only to 10 μg/L while oxidative stress parameters did not show any change compared to controls. A slight negative effect on MXR functionality is observed in mussels exposed to NanArgen formulation in vivo. Chemical analysis confirm Ag exposure and showed a dose-dependent increase of Ag in exposed mussels. In conclusion we can state that this nano silver-based commercial product can induce toxicity even at low concentrations and in short-term exposure scenarios. The observed toxicity of NanArgen underlines the need to further test commercial formulations of nanotechnology-based consumer products instead of bare nanoparticles in order to properly address any risk associated to their use and release into aquatic environment and in non-target aquatic species.

**WE303**

**Effect of gold nanoparticles on feeding, growth and enzymes activity of amphipods**

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The gold nanoparticles are widely used in medical therapy and cosmetics. However, there is a relative abundance of papers focusing on engineered nanoparticles, including both freshwater and saltwater species. The knowledge about the potential ecotoxicity of these nanoparticles is essential before their use by society at a large scale, since they will ultimately be released in the environment. Thus, the aim of this study was to determine the effect of gold nanorods (Au-NR, 45nm) in the feeding rate, growth and aquatic activity of Amphipods *Gammarus duebeni*. A significant decrease in feeding rate and snout to vent length (SVL) of tadpoles was observed at concentration equal or higher than 0.004 μg/ml. For biomass a significant effect was observed at concentration 0.007 μg/ml or higher, though, a decrease in weight gain rate was observed at a lower concentration (0.004 μg/ml). At the biochemical level, the activity of enzyme lactate dehydrogenase (LDH) increased at 0.002 μg/ml of Au-NR, that of catalase (CAT) was significantly reduced at 0.005 μg/ml or higher, and glutathione S-transferase (GST) and acetylcholinesterase activity (AChE) was significantly higher, respectively, to the control, in the two highest tested concentrations 0.007 and 0.01 μg/ml. The
observed reduction in SVL, added to decreased feeding rates, in tadpoles exposed to Au-NR, are important effects that may compromise the fitness of the organisms, since they may cause a delay in the metamorphosis, leading to a longer exposure period of tadpoles to the chemical and to an increase in the time to reach adult and reproductive stage. The higher activity of LDH, at 0.002 µg/mL, may suggest that tadpoles activate first (at low concentrations of Au-NR) a detoxification pathway involving the enzymes LDH and GST. Furthermore, an enhanced reactive oxygen species (ROS) may have led to the inactivation of extracellular antioxidant enzymes related with the mechanisms of cell apoptosis. Thus, the induction of GST at the two highest Au-NP concentrations, suggest that the cells are inactivating the Au-NP by its conjugation with reduced glutathione. The results obtained in the present work indicates that Au-NR may induce several sublethal effects in tadpoles of X. laevis compromising their fitness. Furthermore, since these effects occur at very low concentrations (as long as 0.002µg/mL) it should be classified as “extremely toxic” (EC20 < 0.1 µg/mL; CEC, 1996), suggesting a high environmental risk.

WE304 Interaction of the biocide triclocarban and weathered multiwalled carbon nanotubes (wMWCNT) in freshwater algae: chronic effects & bioaccumulation
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The disposal of various plastic nanocomposites containing multiwalled carbon nanotubes (MWCNT) will occur mainly in the next decades. Thus, MWCNT release into the aquatic environment due to degradation of the polymers is inevitable. Changes in their properties might happen by several abiotic influences, like weathering by sunlight radiation. MWCNT undergo to structural changes compared to their pristine state, like formation of hydroxyl and carboxyl groups on the surface of the MWCNT. As a consequence, weathered MWCNT (wMWCNT) have an altered agglomeration and sorption behavior compared to pristine triclocarban (TCC). This might lead to a different environmental fate of both the wMWCNT and the contaminants in aquatic ecosystems and eventually an enhanced chronic or mixture effect on organisms like freshwater algae. In our studies we examine the chronic effects of wMWCNT and the ‘Trojan horse’ effects of TCC in presence and absence of wMWCNT on Pseudokirchneriella subcapitata and Chlamydomonas reinhardtii. Growth inhibition tests were performed according to OECD test guideline 201. In a first part of experiments, the growth inhibition of both species was tested in the range of 10 – 60 µg/L for TCC and 0.1 – 16.0 mg/L for wMWCNT. The mixture toxicity of a TCC test series (10 – 60 µg/L) and 100 µg/L wMWCNT was additionally investigated on P. subcapitata. A second series of experiments was carried out by adding the highest toxicity (60 µg/L) to variable wMWCNT concentrations to figure out, which wMWCNT amounts are necessary to reduce the toxicity of TCC. We determined a concentration dependent growth inhibition of P. subcapitata for TCC and TCC + 100 µg wMWCNT/L with an EC50 of 37 and 36 µg TCC/L, respectively. This amount of wMWCNT appears to be not sufficient to adsorb the entire free TCC from the water phase, which eventually leads to a higher EC50 values in both scenarios. Only in a second experiment it could be shown, that wMWCNT amounts > 1 mg/L reduce algae growth inhibition completely caused by 60 µg TCC/L. Regarding to mixture effects of TCC and wMWCNT to algae, bioaccumulation of wMWCNTs by freshwater algae needs to be investigated, especially in respect to long term incubation times and low wMWCNT amounts. Acknowledgements The work is supported by the European Project P2-O2-Transfer that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIINN.

WE305 Comparative assessment of the interactive effects of Carbon-based nanomaterials and Benzo[a]pyrene on zebrafish embryos
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This study aimed to assess the ecotoxicological consequences related to the interaction of Benzo[a]pyrene (B[a]P) with two CNMs with different physico-chemical properties, namely carbon nanopowder (CPNP) and fullerene (C60). The aim of this research is to determine if CNPs alone and the effective sorption of the hydrocarbon on CNPs was quantified. A thorough evaluation of chemical-physical interactions between the two CNMs and B[a]P has been performed. Embryos were exposed to CPNP, C60 and B[a]P alone and their combination. The uptake of CNMs and B[a]P and their localization in embryos were assessed by immunofluorescence and electron microscopy. To evaluate the toxic effects due to interaction of B[a]P with CNMs, a set of biomarkers of genotoxicity and oxidative stress was applied. Proteomics analysis allowed also the identification of molecular events involved in the responses to pollutants alone and in co-exposure. Overall results showed that the different physico-chemical properties of the two CNMs influenced their interactions with B[a]P and generated distinct toxic effects. Indeed the adsorption on CNP modified the accumulation of B[a]P, which followed the distribution of the physical pollutant instead of its natural bioaccumulation. On the contrary the co-exposure with C60 did not affect the uptake/distribution of B[a]P. Instead, C60 doped with B[a]P is more prone to sedimentation and less bioavailable for the embryos compared to C60 alone. The integrated results from biomarkers and proteomics showed that different stress response pathways were induced by the pollutants alone respect to their combination. The CNP doped with B[a]P mainly mirrored the effects shown by the physical contaminant rather than by the hydrocarbon, while C60 doped with B[a]P seems to induce a cellular response similar to B[a]P alone. The study highlighted that in the aquatic ecosystems complex interactions are established between pollutants and CNMs which could elicit unexpected ecotoxicological effects.

WE306 In vitro Toxicity of Model ZnO Nanoparticles on Hemocytes of Mussel Mytilus galloprovincialis
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Zinc oxide nanoparticles (ZnO NPs, size 58 nm, as calculated using X-Ray diffraction data) were manufactured through Flame Spray Pyrolysis, and their effects were subsequently investigated on hemocytes of mussels Mytilus galloprovincialis. Following the collection and preparation of cell suspensions, mussel hemocytes were treated for 1 h with different concentrations of ZnO NPs (5, 10, 25 and 50 µg/mL), dispersed with a probe sonicator, as well as ZnCl2 (10 and 25 µg/mL; positive control, from a stock solution of ZnCl2, in 2dH2O, in 1:1 ratio). Afterwards, stress indices such as (a) cell viability (in terms of Neutral Red Retention Time/NRRT assay) (b) the generation of superoxide radicals (O2-) using Nitro blue tetrazolium/NBT, (c) the production of nitrogen oxides (NO, in terms of nitrites), and (d) lipid peroxidation (in terms of malondialdehyde/MDA equivalents) were measured. The results demonstrated a significant increase of cell death after treatment with ZnO NPs at concentrations higher than 5 µg/mL, with maximum values (>50%) of cell death after exposure to ZnO NPs 50 µg mL-1. Furthermore, hemocytes treated with sub-lethal concentrations of ZnO NPs (5-25 µg/mL), showed a significant increase of O2-, NO and MDA, compared to those values observed in control cells in each case. Finally, the results of the exposure to ZnO NPs were compared with the respective results after exposure to ZnCl2, showing a similar pattern. Those effects of ZnO NPs on mussel hemocytes confirm the cytotoxic and oxidative potential of well-promised nanomaterials, such as ZnO NPs, widely used in a variety of new cutting-edge applications.

WE307 Toxico-transcriptomics as tool to identify nano-specific toxicity profiles
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The use of omics is rapidly increasing in the field of nano-ecotoxicology; an increasing number of studies are aiming to investigate the effects and mode of action of engineered nanomaterials (ENM) in this way. However, a systematic integration of transcriptomic datasets in a consistent manner. The pipeline allows a re-mapping of array probe sequences, followed by established statistical analysis and thus improves data set comparability. Differentially expressed genes (DEGs) are determined by comparison between treatment and untreated samples (qFDR ≤ 0.05).

WE308 Zinc toxicity to A549 cells and Daphnia magna changes with iron oxide nanoparticles
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The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is based on their ability to adsorb and immobilize metals and decrease their bioavailability. However, the adsorption of metal contaminants by nanoparticles can also potentially increase the toxicity of either NPs or the metals, for example due the Trojan horse effect. In this study, we evaluated the acute effect of zinc (Zn) as zinc sulfate heptahydrate (ZnSO4·7H2O) after an incubation period with a fixed concentration of humic acid (ha) coated IONPs (ha-IONPs), on the in vitro toxicity to human A549 cells and on the toxicity to Daphnia magna as a model freshwater invertebrate species. Non-toxic concentrations of ha-IONPs were selected for the
assays taking also into account the predicted adsorption of Zn. The ha-IONPs concentrations used were 0.45g/L and 0.52 g/L for the A549 and Daphnia magna experiments, respectively. In A549 cells, the incubation of Zn with ha-IONPs did not change the Zn effects on cell viability after 24h in terms of IC50 (0.006 g/L vs. 0.010 g/L with and without ha-IONPs, respectively). However, the shape of the dose-response curve became shallower (e.g., the IC50 for Zn was 0.070 g/L with and without ha-IONPs, respectively). This indicates a potential protective effect of IONPs at high metal concentrations and a synergistic effect at low metal concentrations. These experiments were also conducted in the presence of serum proteins, and despite the toxicity of Zn decreased, the same effect of co-incubation with ha-IONPs was observed. Optical microscope images showed that ha-IONPs aggregates were uptaken by the cells during the experiments. Therefore, even if adsorbed with ha-IONPs, CNFs were not able to reach intracellular compartments. Differences in the relative uptake of free vs. ha-IONP adsorbed zinc as well as intracellular bioavailability of Zn in these two forms would be explaining the changes in the dose-response curve that were observed. Acute studies (up to 48-hours) with Daphnia magna showed a protective effect of the ha-IONPs on the toxicity of Zn. The EC50 value for Zn increased from 0.23 mg Zn/L to 1.11 mg Zn/L in presence of ha-IONP. According to DLS data, the adsorption of Zn to NPs decreased their stability and subsequently increased their adsorption to the capping agent in the exposure media. This settling process would decrease the bioavailable zinc concentration in the exposure medium and therefore its toxicity in Daphnia magna.

WE309 Internalization of graphene-related nanomaterials in fish cell lines

The H2020 NanoReg2 project aims to develop and implement grouping and Safe by Design strategies for nanomaterials (NMs). For this purpose, toxicity of selected carbon-based NMs have been assessed in order to refine Safe by Design approaches considering three pillars: safer product, safer use, and safer production process. Graphene-related nanomaterials (GRMs) are among the newest and most important NMs. However, regulatory frameworks have attracted great interest in many areas of science and industry. Nevertheless, the incorporation of these NMs into products inevitably leads to their release into the aquatic environments. In a previous study we assessed the cytotoxicity of tubular-shaped carbon nanofibers (CNFs) and graphene oxide (GO) on fish hepatocytes (derived from topinnow fish, Porelliscis ludica) and macrophages (derived from carp leukocytes, Cyprinus carpio). In general, the observed IC50 values after 72h exposure were higher than 100 µg/ml with some exceptions in the case of CLC cells. In the present work we focussed on the uptake and intracellular fate of these NMs. Cells were exposed to three different concentrations (non-toxic, low toxic and relative toxic) of each NM for 72 h. Transmission electron microscopy was used to investigate possible internalization and intracellular fate of these NMs in hepatocytes and macrophages. All GRMs were visualized in both cells even at the lowest exposure concentrations. Carbon nanofibers were taken up into vesicles of hepatocyte cells in a size-independent manner, whereas in macrophages, longer CNFs were encountered free in the cytoplasm and only the shorter CNFs were localized in membrane-bound compartments. GO sheets were present within vesicles as well as free in the cytoplasm of both cell types. Understanding the behaviour of these NMs in fish will allow the development of safer products containing them with temperatures and salinity. This research is supported by the EU’s Horizon 2020 research and innovation programmes (NanoReg2, Grant Agreement n° 646221 and MSCA-IF-2016, Grant Agreement n° 746876).

WE310 Molecular mechanism and physicochemical properties of Cadmium-TiO2 nanoparticle mixtures when co-exposed to the nematode Caenorhabditis elegans
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The number of engineered nanomaterials (ENM) is rising continuously in consumer and environmental and soil systems is very important but rare. Nanoscale titanium dioxide (nTiO2) is probably among the most relevant ENMs with a projected accumulation rate in European river sediments of 1.4 mg g−1 yr−1 (Gottschalk et al., 2009). Incubations of Angelstorf et al. (2014) have shown that nTiO2 is far more toxic to the nematode Caenorhabditis elegans than bulk TiO2, especially under simulated solar radiation (SSR), probably a consequence of its photocatalytic property. Further experiments by Samet (2017) focused on the interaction of nTiO2 with cadmium (Cd), another environmental contaminant. C. elegans was exposed to nTiO2 (P25, primary particle size of 21 nm) and Cd in single and co-exposure for 72 h under dark conditions and SSR. Choosing growth and reproduction as toxic endpoints, co-exposure with 40 mg L−1 nTiO2; and 50 µg L−1 Cd under SSR led to a synergistic inhibitory effect of 80 % of reproduction, twice as high compared to nTiO2 alone. As Cd is known to induce intracellular calcium signaling as part of protective cell processes (Thévenod, 2009), in the study presented here, the effect of the mixture on intracellular calcium release will be investigated applying the following methods: 1) The molecular mechanism of nTiO2 and Cd will be investigated with NS8593, a known human TRPM7 ion channel blocker. Because of high reproduction inhibition, the TRPM-like channel gene gon-2 could interact with the mixture. Gon-2 is responsible for gonadal cell division in C. elegans. If Cd is a Ca2+ and nTiO2 a blocker of TiO2, they may exhibit a higher sensitivity (due to the mixture on intracellular calcium release). 2) The mode of action of nTiO2-Cd-agglomerates is still not identified. They could interact if Cd is bound to nTiO2 or if Cd and nTiO2 are in close proximity. The impact of nTiO2-Cd-agglomerates will be examined using calcium as a potential competitive ligand. 3) The photocatalytic activity of nTiO2 could damage cell membranes under SSR and Cd could enter the cell. Measurements of membrane integrity with propidiumiodid and hexokinase will be applied. First results will be presented. Angelstorf et al., 2014. Environ. Toxicol. Chem., 33, 2288-2296. Gottschalk et al., 2009. Environ. Sci. Technol., 43, 9216-9222. Samet, Abstract SETAC Brussels 2017. Thévenod 2009. Toxicol. Appl. Pharmacol., 238, 221-39.

WE311 Influence of temperature and salinity on toxicity of zinc oxide nanoparticle on the marine copepod Tigriopus japonicus
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Zinc oxides (ZnO) are among the newest and most important nanomaterials (NMs) in commercial products. About 93% of ZnO-NP-containing products are paints, cleaning and personal-care products, from which ZnO-NP can be easily leached. Annually, around 250 tonnes of ZnO-NP were estimated to be released from sunscreens alone into the marine environment. However, there are no comprehensive regulations of NMs, including ZnO-NP, in any countries due to the diverse physicochemical properties of NMs and their complicated interactions with the environment. In the marine environment, ZnO-NPs are exposed to various environmental factors, such as temperature and salinity, but influences of these factors on the physicochemical properties and toxicity of ZnO-NP are often tested individually. As both factors co-exist in the environment and may influence one another, it is vital to study their effects concurrently to tease out any potential interactions. This study, therefore, investigates the interacting effects of temperature and salinity on ZnO-NP to a common marine copepod (Tigriopus japonicus) along the Western Pacific coast. Physicochemical properties (aggregate size & ion dissolution) of three zinc-associated compounds, including ZnO-NP, ZnO bulk-particles (ZnO-Bulk) and ZnSO4·H2O (ZnSO4), were characterized to compare their toxic mechanisms. Acute toxicity was determined with 96-h standard toxicity tests under nine different combinations of temperature (15, 25 & 35 °C) and salinity (12, 22 & 32 PSU), i.e., a 3 x 3 factorial design. Preliminary results showed that increase in temperature and salinity could increase aggregate size of ZnO-NP and ZnO-Bulk, but reduce their ion dissolution rate. At 25 °C, similar to previous studies which suggest that ZnO-NP is a Ca2+ and nTiO2 a blocker of TiO2, they may exhibit a higher sensitivity (due to the mixture on intracellular calcium release). Higher toxicity of ZnO-NP and ZnO-Bulk might be due to particle and animal interactions such as physical damage by larger aggregate at larger salinity. The results will advance our understanding of interactions of zinc with temperature and salinity from which it will be able to determine effect threshold concentrations for regulation of products of ZnO-NP under different combinations of these two environmental factors.

WE312 Multigenerational effects of gold nanorods to Raphidocelis subcapitata and Chlorella vulgaris
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In real scenarios, exposure to nanoparticles may occur over several generations, which may exhibit a higher sensitivity (due to the accumulation of adverse effects) or tolerance (due to phenotypic plasticity mechanisms) to the nanoparticle. The aim of this study was to evaluate the multigenerational effects of gold nanorods (Au-NR) ranging from 8 to 90 nm, for 72h. At the end of the assays, growth rate was determined for all generations of each alga. The following physico-chemical parameters of Au-NR concentrations were monitored: size, morphology and total concentration of Au. In addition, the toxicity of the capping agent
cetyltrimethylammonium bromide (CTAB) was quantified by exposing both algae to the concentration of CTAB present in the highest tested concentration of Au-NP: 90 μg/L for C. vulgaris corresponding to 0.257 mM of CTAB. Chlorella vulgaris exhibited a higher tolerance to Au-NP than R. subcapitata: EC50,72h for F0 was 79 μg/L and 39 μg/L, respectively. For C. vulgaris, a gradual increase of its tolerance to Au-NP was observed over generations; after being exposed for four generations to this chemical, a significant effect on growth rate were nanoparticle between all concentrations and the control. A different pattern of response was observed for R. subcapitata. This species significantly increased its sensitivity to Au-NP from F0 to F2 generation, but recovered a similar sensitivity to that quantified for F0 from F2 to F4. CTAB significantly reduced the growth of microalgae by 42%. Over generations, the sensitivity to the two algae species to CTAB was not changed. The results obtained in the present work reveal that traditional standard assays with short-term exposure may over- or underestimate the real risk posed by Au-NP to freshwater microalgae. Therefore, it is suggested that long-term exposures should be included in the ecological risk assessment.

**WE313 Effects of climate change combined with copper nanoparticle on early development of Japanese medaka (Oryzias latipes)**

I. Meng Ian, Y. Zhang, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung Nowadays, global warming and acidification were occurred by rising carbon dioxide (CO2). The factory have been continuously emit copper nanoparticle into ocean and river. They probably induced harmful biological effect on organisms. However, the combined effects of three environmental stressors on aquatic species have not been well studied. The purpose of this study is to assess the effects of aquatic acidification and warming combined with copper nanoparticle on survival and hatchability of early development of Japanese medaka (Oryzias latipes). Firstly, the embryonic development was exposed to 25°C/6.5, without copper nanoparticle under nine temperature and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5) for 14 days to observe hatchability and mortality. Then, the newly hatched fry were exposed to same condition for 14 days to observe the survival. Results showed that the mortality of embryos and fry was increased, and the hatching rate had a downward trend in exposure group of pH 5.5 compared with that of others pH groups. However, only 28°C/5.5 combined with copper nanoparticle group was significantly increased mortality and inhibited hatchability than that of 28°C/6.5 combined with copper nanoparticle group. While the survival rate of larvae had a significantly downward trend in exposure groups of lowest pH level and highest temperature on days 10. In conclusions, medaka larvae have more sensitive than embryos by survival ability. Moreover, aquatic acidification and warming were synergistic effect to increase copper nanoparticle toxicity to larvae. Therefore, we found that three environmental stressors caused a potential hazards to fish population.

**WE314 The use of the marine mussels Mytilus hemocytes as a model for studying the impact of NPs on innate immunity**

M. Auguste, University of Genova / DISTAV, T. Bali, L. Canesi, university of genou / DISTAV Nanoparticles (NPs) are widespread used in consumer products and industry; they are growing in number and interacting with both aquatic species and organisms. The use of the marine mussels Mytilus edulis and M. galloprovincialis, for in vitro testing is a valuable tool in the screening of the toxicity of NPs as the tests are inexpensive and use alternative animals in experimental set-up, avoiding the use of animals. Many studies are performed with biological immune parameters (e.g. lysozyme membrane stability, superoxide and NO production, phagocytic activity and particle internalisation by hemocyte upon short- to exposure to NPs (different concentrations and times of exposure from 30 min to 1h). Once entering the organism, NPs are in contact with other type of media e.g. hemolymph serum for mussels. For some type of NPs, the response is affected by the presence of protein components of hemolymph serum involved in the formation of a NP-protein corona. In order to have a wider view of the interactions and mechanisms of actions of NPs, the same parameters are measured with NPs suspensions in artificial seawater (ASW) and serum. The results obtained with Mytilus hemocytes will be compared with those obtained in immune cells of other model organisms within the PANDORA project. According to the special properties of every NPs, the aim is to understand the main mode of action at the cell level that will help designing predictive in vitro assays to measure the immuno-risk of NPs to the environment in the future. * Funded within the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement PANDORA No 671881.

**WE315 Influence of warming and acidification on copper nanoparticle bioaccumulation in medaka (Oryzias latipes) embryo**

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The level of atmospheric CO2 has elevated significantly since the Industrial Revolution, leading to global warming and ocean acidification. With the development of industry and technology, many environmental contaminants such as copper nanoparticle (CuNPs) may be exposed to environment. However, it is unclear whether the accumulation of copper nanoparticles in organism will increase under the warming and acidification scenarios. Therefore, the purpose of this study is to investigate whether CuNPs (25 nm, 0.03 mg/L) will accumulate in Japanese medaka (Oryzias latipes) embryo under the condition of elevated temperature and pH and different combinations of acidification and warming. The medaka embryo was followed for four consecutive days at nine temperature and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5). Results showed that the temperature and pH did not affect the accumulation of CuNPs, respectively. When combined with temperature and acidification factors, Cu accumulation of group 30°C/6.5 was increased significantly than that of groups 26°C/6.5, 26°C/5.5, and 30°C/5.5. However, it revealed that there was no significant evidence of warming and acidification on increased Cu accumulation of medaka embryo. Therefore, we concluded that there was no influence of Cu accumulation in medaka embryo when warming and acidification occurs in the future.

**WE316 Assessing the combined toxicity of metals and metal-oxide nanoparticles in a benthic estuarine microalga**

R.B. Ogunjumobi, M. Yallop, G. Barker, University of Bristol

Coastal aquatic ecosystems such as estuaries are at risk of metal pollution due to anthropogenic inputs from acid mine drainage, industrial and agricultural run-off. In addition, advances in technology in the last decade have increased the production engineered nanomaterials (ENMs) used widely in fields such as medicine, energy, agriculture and consumer goods production. As a result, there are increasing concerns about the release of engineered nanomaterials such as metal oxide nanoparticles into the environment. While the effect of metals and ENMs as single contaminants have been extensively studied, much research is needed to account for potential mixture effects due to heavy metal-ENMs interactions. Studies suggests that the toxicity of ENMs such as metal oxide nanoparticles is mainly due to the release of dissolved metal ions. However, majority of these studies have mainly focused on impact of ENMs in freshwater environment and results are extrapolated for other types of environmental systems (marine, soil, sediment). Evidence is accumulating that the dissolution of ENMs is dependent on the characteristics of the exposure medium. Meta-analysis of the characteristics of the exposure medium. Meta-analysis of the characteristics of the exposure medium. Metabolism of ENMs in freshwater microalgae - *Cylindrotheca closterium*. We hypothesize that the aggregates formed by the metal oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction and metal toxicity. We also hypothesize that the metal oxide nanoparticles in a benthic estuarine microalgae - *Cylindrotheca closterium*. We hypothesize that the aggregates formed by the metal oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction and metal toxicity. We also hypothesize that the metal oxide nanoparticles in a benthic estuarine microalgae - *Cylindrotheca closterium*. We hypothesize that the aggregates formed by the metal oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction and metal toxicity. We also hypothesize that the metal oxide nanoparticles in a benthic estuarine microalgae - *Cylindrotheca closterium*. We hypothesize that the aggregates formed by the metal oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction and metal toxicity. We also hypothesize that the metal oxide nanoparticles in a benthic estuarine microalgae - *Cylindrotheca closterium*. We hypothesize that the aggregates formed by the metal oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction and metal toxicity. We also hypothesize that the metal oxide nanoparticles in a benthic estuarine microalgae - *Cylindrotheca closterium*. We hypothesize that the aggregates formed by the metal oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction and metal toxicity. We also hypothesize that the metal oxide nanoparticles in a benthic estuarine microalgae - *Cylindrotheca closterium*. We hypothesize that the aggregates formed by the metal oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction and metal toxicity.
hypertrophy of gill mucus. We have assumed that ion dissociation will be a key to understand nano-toxicity depended on materials. TiO$_2$-NP which does not dissociate ions, was employed as a reference to ion dissociation NP (i.e. SNCs). In exposure of TiO$_2$-NP (at 10 mg/L) to embryo and larvae, there was no biological toxic effect mentioned above at all. In our presentation, we will discuss comparative toxicity of SNCs and TiO$_2$-NP regarding general toxicity, oxidative stress, cytotoxicity (apoptosis and necrosis), immunity-toxicity, and tolerance to oxidative and bacterial disease. Through this study, we will figure out that dissociated ions should be toxic essential of nanomaterials, and not always nano-sized material will be toxicant in aquatic environment.

WE318
Genotoxicity assessment of aluminium oxide nanoparticles in relation to Escherichia coli and Aeromonas hydrophila
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Increasing production and use of nanomaterials contributes to their widespread dissemination in the environment and their unique physical and chemical properties lead to unlimited distribution in environmental compartments. Migration ability of nanoparticles can have very dangerous consequences, as they can be transferred to potable water. Genotoxicity biomarkers are regarded as useful tools for the assessment of chemical hazards in aquatic ecosystems, because chemicals which damage DNA can significantly alter the functioning of ecosystems. Recent advances in molecular biology have led to the development of new in vitro techniques, which can be used for DNA analysis in the field of genetic ecotoxicology. The randomly amplified polymorphic DNA (RAPD) method is a PCR-based technique that amplifies random DNA fragments with the use of single short primers of arbitrary nucleotide sequence under low annealing conditions. RAPD-PCR test has been used successfully for detection of genetic damage in animals and plants. The S-9 system, which is part of the mammalian induction system, is based on the induction, by genotoxic compounds, of a bacterial SOS repair system conjugated to the b-galactosidase gene and the subsequent measurement of the enzyme expression. In this work, genotoxicity studies on the basis of the RAPD-PCR and SOS-Chromotest assay were performed for aluminium oxide nanoparticles (nano-Al$_2$O$_3$). Lysis of bacteria on the rate, transport, and effects of nanomaterials, including metal based particles such as nano-Al$_2$O$_3$, in the environment. The interest in nano-Al$_2$O$_3$ is due to the fact that their influence on genetic material of bacteria is practically unknown. Results obtained for the nanocompound were compared with those for Al$_2$O$_3$ macro form. The nanocompound caused changes in the genetic material of bacteria A. hydrophila. Decrease of genetic stability of obtained profiles bands for TiO$_2$ was different from the results obtained for the negative control by more than 27.3%, while from positive control - only by 15.6%. Furthermore, the largest decrease in genetic stability was 89.3%. The values of genotoxicity induction coefficient (K) in the SOS-Chromotest showed strong genotoxicity for nano-Al$_2$O$_3$, in the presence of S9 fraction and slight genotoxicity in the absence of S9 fraction in mutants of Escherichia coli. The results showed also that nano-Al$_2$O$_3$ can induce genotoxicity a greater extent than the same compounds in their macro form.

WE319
Effects of Copper Oxide Nanoparticles and Arsenic on the Whole-Life Cycle of Rice (Oryza sativa japonica)
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Copper oxide nanoparticles (nCuO) and arsenic (As) phytotoxicity to rice plants (Oryza sativa japonica) was evaluated in a factorial study using (0, 0.1, 1.0, 10, 50, and 100 mg/L) in daily watering and As (0 and 10 mg/kg) in soil. Experiments were conducted in a greenhouse during 130 day interval. Two rice plants were grown in 3L plastic pots without drainage. Toxicants were quantified in soils and water by inductively coupled plasma-mass spectrometry before, during and after testing. nCuO particle sizes were determined by differential light scattering before addition to the test system. Exposures began at planting, continued through germination, and to seed production. Thus, our study is the first to examine the influence of nCuO in combination with As in the whole life cycle growth of rice plants. No significant effect was observed on the seed germination, but both nCuO and As had a significant main effects on the fresh weight (FW) of rice straw and the number of rice panicles (NP). The interaction of the two toxicants was also significant on both FW and NRP. A decrease in the FW was observed for rice exposed to As, only. The midlevel concentrations (1.0 and 10 mg/L) of nCuO decreased the FW with no As addition, while higher concentrations (50 and 100 mg/L) significantly increased the NRP. Low and high nCuO concentrations (0.1, 50, and 100 mg/L) decreased the FW with the As addition, and NRP decreased in treatments receiving As along with either lower or higher nCuO concentrations. More data from this greenhouse study are currently being compiled and analyzed to determine the effect of As and nCuO on grain yield as well as Cu and As uptake, distribution, and speciation in rice plants and the grain.

WE320
Behavior of cerium oxide nanoparticles in presence of pharmaceuticals
S. H. deo, P. D. d'Almeida, N. doskocz, M. Zalęjska-Radziwill, A. Affek, Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering / Department of Biology
Cerium oxide nanoparticles (CeO$_2$-NPs) on three aquatic specimens- algae Selenastrum capricornutum, bacteria Vibrio fischeri, and activated sludge, by exploring concentration-dependent effect and changes induced due to the presence of lbuforpen (Ibu) or Levofloxacin (Levo). 72h algae growth-inhibition, marine bacterium-haemolysis-reduction and 24h sludge enzymatic activity and oxidative stress were used as endpoints. Nanoparticles concentration ranged from 0.6 to 160 mg L$^{-1}$. The particle size and the ζ-potential of NPs in the culture media were measured to analyze the relation between stability profile and the observed toxicity behavior. The obtained results reveal toxic effects of CeO$_2$-nanoparticles leading to growth inhibition in algae. The presence of Ibu did not produce significant changes, while Levo showed drastic negative effect in algae growth. Short-term exposure produced significant reduction of hemolucence intensity in marine bacteria. The presence of both, Ibu or Levo, reduced the negative effects of single nanoparticles in Vibrio fischeri. Exposure produced significant oxidative stress in bacteria forming activated sludge, with lower damage to enzymatic activity. The presence of pharmaceuticals compounds did not produce significant changes on nanoparticles behavior for activated sludge. Results indicated that algae was more strongly affected than the marine bacteria and activated sludge, respectively. These can be attributed to the culture media and organisms structural characteristics, respectively. [1] Neale PA, Jamting AK, O'Malley E, Herrmann J, Escher BI. 2015. Behaviour of titanium dioxide and zinc oxide nanoparticles in the presence of wastewater-derived organic matter and implications for algal toxicity. [2] Sahle E, Demese E, Chadwick E, Am Z, Bill H, Heidi G. 2016. Interaction of engineered nanomaterials with hydrophobic organic pollutants. Nanotechnology 27:284003. Acknowledgement - The research was funded by the Comunidad de Madrid, grants S2013/MAE_2716 REMTFAVARES.

WE321
Toxicity of nanoparticles of titanium dioxide to Daphnia longispina: waterborne versus dietary exposure
E. Padilla, Institute for Environmental Sciences / University Koblenz-Landau; C. Venancio, Department of Biology / I. Lopes, University of Aveiro / Department of Biology / D. longispina / nanomaterials (TiO$_2$-NPs) on three aquatic specimens. Results indicated that algae was more strongly affected than the marine bacteria and activated sludge, respectively. These can be attributed to the culture media and organisms structural characteristics, respectively. [1] Neale PA, Jamting AK, O'Malley E, Herrmann J, Escher BI. 2015. Behaviour of titanium dioxide and zinc oxide nanoparticles in the presence of wastewater-derived organic matter and implications for algal toxicity. [2] Sahle E, Demese E, Chadwick E, Am Z, Bill H, Heidi G. 2016. Interaction of engineered nanomaterials with hydrophobic organic pollutants. Nanotechnology 27:284003. Acknowledgement - The research was funded by the Comunidad de Madrid, grants S2013/MAE_2716 REMTFAVARES.

WE322
Dynamics of Cu accumulation in charophyte cell compartments after its exposure to nCuO
Manusri Nadagouda, NatureResearch Centre / Institute of Botany, Laboratory of Aquatic Ecotoxicology; B. Gylte, S. JURKIENI, R. Vitkus, Nature Research Centre / Institute of Botany
In plant and bacterial cells, prior to be internalized, NPs have to pass semipermeable cell wall and plasma membrane barrier. Metal nanoparticles may interact with the cell directly or induce toxicity through the release of metal ions. Intracellular chelation of characean green alga poses features such as big size, and separation of the main cell compartments, which enable mechanical separation of the compartments, namely cell wall, cytoplasm and vacuole. In this study, fractionation procedure was verified by cyttoplasm and vacuole specific biomarkers.
malate dehydrogenase and α Mannosidase, respectively. A high-purity vacuolar (99.5%) and cytoplasm (86.7%) fractions of the cells of Nitellosis obtusa were obtained. The cell wall fraction contained approximately 1.8 and 13.4% of cytoplasm and vacuole. By additional washing of the cell wall it was possible to diminish contamination with cytoplasm. The data on Cu accumulation dynamics within the compartments after cell exposure to rCuO suspensions will be presented and the role of the cell wall in the accumulation process will be discussed.

WE323 Are graphene nanomaterials "Trojan horse" carriers for oil compounds in mussel hemmexos in vitro? G. Nicolussi, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology, Science and Technology Faculty and Plentzia Marine Station, University of the Basque Country (UPV/EHU), Basque Country, Spain; A. Katsumiti, M.P. Cajaraville, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE

In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are priority pollutants and main constituents of the water accommodated fraction (WAF) of petroleum. Graphene nanoplatelets can adsorb organic compounds thus being potentially useful in oil spill remediation. However, they could also act as vehicles of organic contaminants to aquatic organisms ("Trojan horse" effect). This study aimed to evaluate the "Trojan horse" carrier property of graphene nanoplatelets. This work was funded by the EU H2020 (GRACE project (grant 679266), Spanish MINECO (project NACE, CTM2016-8130-R), Basque Government (consolidated research group IT810-13) and University of the Basque Country (UI) 11/37).

WE324 Multigenerational effects of titanium dioxide and silver nanoparticles on Daphnia magna: gene expression and morphological changes in the presence or absence of aged nanomaterials L.A. Ellis, The University of Birmingham / GIES; E. Valsami-Jones, University of Birmingham / School of Geography Earth and Environmental Sciences; I. Lynch, University of Birmingham / Geography Earth Environmental Science

Recent studies have investigated nanoparticle (NP) physicochemical properties and interactions with biological systems. Daphnia magna was chosen as the model organism, as they are well characterized and reproduce parthenogenetically, which is well suited for experimental genetic studies and monitoring stress/adaptive change to their environments. Herein, we investigated key biological endpoints, such as survival, growth, reproduction, and reversibility of pathways in response to exposure to silver (AgNPs) and titanium dioxide (TiO2) nanoparticles (NPs). Particles were either pristine or aged, uncouated or stabilized with either PVP or sulphide (AgNPs only). Our aims were to identify specific stress responses from NPs which could lead to molecular defects in order to understand if: (1) different NP compositions induce the same pathways and effects; (2) exposure in the presence of suspensions such as natural organic matter changes the pathways and/or severity of changes observed; and (3) if the ageing of particles make them more or less toxic; (4) if long-term low dose exposure (25 days, EC20 concentrations) leads to developmental and reproductive changes, and (5) whether these NP-exposure induced changes to the F0 generation are passed onto subsequent generations, who themselves are not exposed directly. In all cases, both morphological changes and expression of key biomarkers were analysed in order to identify whether chronic exposure to NPs induces stress responses. We observed morphological changes, including eyes and tail defects, to each of the subsequent F1-F3 generations. We also observed differences in gene expressions compared the control populations, supporting that AgNP and TiO2 do have toxicological impacts from chronic exposure irrespective of particle aging. TEM observations of consequent histological accumulation of the TiO2 and AgNPs supported the assumption that NPs manifest themselves as particulates. We were also able to see some recovery in the F3 generations that had their subsequent parent generations removed from exposure. The influence of biomolecules secreted by the organisms in response to the presence of NPs, and the influence of humic acid containing marine mussels during the exposure phase were also investigated, providing important insights regarding the need for realistic exposure scenarios during chronic exposure scenarios.

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (P)

WE325 Evaluating the contribution of environmental stressors to sediment concentrations of PAHs in the northern Gulf of Mexico L. M. Barrieux, Louisiana State University; H. Rockett, R.J. Portier, Louisiana State University / Environmental Sciences

Toxicity associated with organic pollutants in aquatic sediments has not been fully characterized for the major estuarine and marine systems of coastal Louisiana. As such, five inshore and three offshore transects of the Mississippi River delta were sampled for sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and environmental variables. From 2012 to 2014, five environmental variables were measured in the northern Gulf of Mexico including: 1) water column depth and salinity 2) surface temperature and dissolved oxygen and 3) temperature of the overlying water column, and 4) the percent sediment moisture and 5) percent organic matter of the aquatic sediment. A main effects-model was implemented in order to assess the impact of environmental variables on the concentrations of ten PAHs and three toxicity indicators in freshwater and marine sediments. A backwards, step-wise linear regression analysis of variance (ANOVA), generalized linear model (GLM) was performed to determine significant effects of measured environmental parameters. The most important environmental variables affecting the concentrations of the measured compounds were those describing the characteristics of the aquatic sediments. The percent moisture of the sediment was the most important environmental parameter, significantly affecting eight of the ten organic pollutants and all three toxicity indicators. Percent organic matter of the sediments was the second most significant parameter, accounting for the variability in concentration for five of the measured pollutants. Temperature was significant for three of the PAHs and TEQ, and in every instance it had a negative effect on concentration. Dissolved oxygen of the water column was a significant variable on the concentration a single organic compound. Water column depth and salinity did not have a significant effect on the concentration on any of the constituents. The most significant environmental variables accounting for the variability of sediment PAH concentrations, included sediment moisture and organic matter. The physiochemical properties of the overlying water column had little to no significant effect on the concentrations of the majority of the measured pollutants. The current research suggests that sediment organic compounds in the northern Gulf of Mexico's estuaries and tidal flats, R.J. Portier, Louisiana State University / Environmental Sciences

Evaluating the contribution of environmental stressors to sediment concentrations of PAHs in the northern Gulf of Mexico

WE326 Microbial resistance to chemical pollution by urban effluents might be triggered by desiccation events. F. Romero, S. Sabater, ICRA Catalan Institute for Water Research; O. Pereda, University of the Basque Country; l. sabater, CSIC-IDAEA / Department of Environmental Chemistry; C. Font, V. Acuña, ICRA Catalan Institute for Water Research

Freshwater ecosystems are subjected to different anthropogenic pressures. Among them, wastewater treatment plant (WWTP) effluents can represent a significant proportion of total discharge, mostly in regions suffering from water scarcity. WWTP effluents contain a mixture of assimilable and toxic compounds, which concentration ultimately determines the effect of the mixture on freshwater biota. Moreover, overexploitation of water resources together with climate change-derived pressures is causing drought events leading to desiccation to increase in number and intensity. To date, little is known about how desiccation events shape the response of river microbial communities to WWTP effluents. The present study used 24 experimental channels in a replicated regressional design to evaluate how an acute desiccation event shapes the response of a complex microbial community (i.e. a river biofilm) exposed to a dilution of a WWTP effluent. We found that desiccation and wastewater effluent significantly affected bacterial community and key biofilm processes such as photosynthesis, denitrification and methanogenesis. After the desiccation event, the biofilm associated to coarse sediment showed a stimulatory effect even at low dilution factors, which was not observed under control (i.e. no desiccation) conditions. Our results seem to indicate a simplification of the biofilm community after the desiccation event and a subsequent co-tolerance phenomenon. We argue that the acute desiccation event
reduced diversity, selecting for resistant species. These resistant species could benefit from low dilution factors of wastewater effluent. Given that microbial metabolism processes biogeochemical cycling in ecosystems, we argue that functioning of freshwater ecosystems may be shaped as a result of the combined action of climate change-related stresses such as desiccation and chemical pollution.

WE237 Synergy effects of fluoxetine and variability in temperature lead to proportionally greater fitness costs: A multigenerational test
M. Oliveira, University of Aveiro; N. Inocêntes, Department of Biology CESAM University of Aveiro / Bilo; A.M. Soares, University of Aveiro / department of Biology & CESAM; M. Barbosa, Department of Biology & CESAM - University of Aveiro / Biology
Increased variability in water temperature is predicted to impose disproportionally greater fitness costs than mean increase in temperature. Additionally, water contaminants are currently a major source of human induced stress likely to produce fitness costs. Global change models forecast an increase in these two human induced stresses. Yet, in spite the growing interest in understanding how organisms respond to global change, the joint fitness effects of water pollution and increased variability in temperature remain unclear. Here, using a multigenerational design, we test the hypothesis that exposure to high concentrations of fluoxetine, a human medicine commonly found in freshwater systems, causes greater lifetime fitness costs when associated with increase variability in temperature. Although fitness is a trade-off, we can be sure that fitness is decreased when both stressors acted together. When only one stress was imposed alone, when both stressors acted together the costs were disproportionally greater. The combined effect of fluoxetine and variability in temperature led to a reduction of 37% in lifetime reproductive success and a 17.9% decrease in population growth rate. Interestingly, fluoxetine and variability in temperature had no effect on the probability of survival. Freshwater systems are of the most imperilled ecosystems, often suffering from multiple human induced stressors. Our results indicate that aquatic organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress acts on alone. Our study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE238 Influence of extreme heat events in the recovery capability of Mytilus galloprovincialis exposed to mercury contamination
F. Coppola, Department of Biology & CESAM - University of Aveiro / Biology; B.M. Henriques, CESAM - University of Aveiro and CIFAR University of Porto / Department of Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; R. Freitas, University of Aveiro / Departamento de Biologia CESAM; E. Figueira, University of Aveiro / Bio Tech CESAM; M.E. Pereira, CESAM University of Aveiro / Department of Chemistry
Several studies already described the impacts caused by metals in estuarine species, often showing the effects of exposure or mercury contamination. Our results indicated that mussels exposed to mercury (Hg) after recovering from the previous heat event showed better performances, which may be associated with the recovery of metabolic and oxidative stress markers in mussels related to Hg exposure. Nevertheless, our results indicate that the effects of temperature and mercury are not additive alone, when both stressors acted together the costs were disproportionally greater. The combined effect of fluoxetine and variability in temperature led to a reduction of 37% in lifetime reproductive success and a 17.9% decrease in population growth rate. Interestingly, fluoxetine and variability in temperature had no effect on the probability of survival. Freshwater systems are of the most imperilled ecosystems, often suffering from multiple human induced stressors. Our results indicate that aquatic organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress acts on alone. Our study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE239 Impacts of ocean warming and BDE-209 contamination on the energy budget of juvenile white seabream (Diplodus sargus)
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Climate change and chemical contamination are global environmental threats of growing concern for the scientific community and regulatory authorities. Yet, the impacts and interactions of both stressors (particularly ocean warming and emerging chemical contaminants) on the physiological responses of marine organisms remain unclear and require further research. In this context, our main goal was to study, for the first time, the effects of warming (+5 °C, i.e. 24°C) and accumulation of a polychlorinated diphenyl ether congener (BDE-209, brominated flame retardant) by dietary exposure on the energy budget of juvenile white seabream (Diplodus sargus; 3.5-2 g total body weight), used as a model. Specifically, growth (G), routine metabolism (R), excretion (faeces, F) and nitrogenous losses, U and food consumption (C) were calculated to obtain the energy budget. The results demonstrated that the energy proportion spent for growth dominated the mode of the energy allocation of juvenile white seabream (50.0-67.8%), including even under the synergetic impact of warming and BDE-209 exposure. On the other hand, energy loss via faeces was significantly higher under control temperature and BDE-209 exposure (16.0%). In all treatments, the energy channelled for metabolism was around 26% and a smaller percentage was channelled for excretion (faeces: 4.3-16.0% and ammonia: 2.3-3.3%). In general, the parameters were significantly affected by increased temperature and exposure to the flame retardant, with higher levels found under warming conditions (for wet weight, relative growth rate, protein and ash contents), BDE-209 exposure (only for O:N ratio) or under both stressors (for ammonia excretion rate and routine metabolic rate). On the other hand, lower viscoserotic index (VSI) was observed under warming and lower fat content was observed under both stressors. Overall, with such extreme and expected conditions of warming and contamination, the energy budget of marine fish species is expected to be greatly affected, leading to impacts on fish fitness and distribution. This study aimed to understand how genotype and environmental conditions change fitness and stress markers in juvenile white seabream exposed to both stressors and emerging contaminants are needed to better understand and forecast their ecological effects, in order to implement potential mitigation measures.

WE330 Transgenerational effects of pesticide on vector mosquito Culex pipiens under global warming
T. Tran, L. Janssens, KULeuven; K.V. Dinh, DTU Technical University of Denmark; R. Stoks, University of Leuven / Department of Biology
Recent transgenerational studies have shown that some species could acclimate to warming and pesticide separately. Transgenerational plasticity is even being considered as a powerful mechanism to enhance species resilience to projected warming. However, it is unknown how exposure to pesticide under warming in the parental generation will shape the offspring susceptibility to these stressors, specifically in vector species. We studied the transgenerational effects of single and combined exposure to warming (4°C increase) and the pesticide chlorpyrifos on life history traits and anti-predator behaviors of the vector mosquito Culex pipiens using a full factorial transgenerational design. Parental warming and pesticide exposure either warming or the pesticide, had negative effects on the offspring: both parental exposure to warming and to the pesticide resulted in an overall lower offspring survival. Parental warming impaired the anti-predator behaviors of the offspring by decreasing the diving proportion and diving time off the offspring. Within both the parental and the offspring generations, warming made the pesticide more toxic in terms of survival. However, this synergism disappeared in the offspring of parents who had been exposed to both stressors simultaneously because in this condition the pesticide was already more lethal at the lower temperature. For anti-predator behaviors, in both generations the two stressors reduced diving time in a synergetic way. In the parental generation, the effect of pesticide were stronger at 20°C than at 24°C. In the offspring generation, this synergetic effect depended on parental temperature. Pesticide induced stronger reduction in diving time at 20°C than at 24°C but only in the offspring of parents exposed to 20°C. Our results indicate that transgenerational effects will not increase the ability of this vector species to deal with pesticides in a warming world. This study highlights the importance of using bifactorial transgenerational experiment to understand the combined impact of pesticide and warming across generations, hence to assess the efficacy of vector control in a warming world.

WE331 1 + 1 ≠ 2: Heritage-dependent synergistic development responses in copepods exposed to predator cues and copper
T. Lode, G. Beuchele, A. Marques, J. Titelman, University of Oslo / Department of Biosciences; K. Hjelland, Department of Biosciences, University of Oslo, Norway / Department of Biosciences; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences
This study examines sub-lethal developmental effects of combinations of predator cues (kairomones, threespine stickleback) and copper (20 μg Cu L⁻¹) on the marine copepod T.твержда. Focusing on nauplii development, the aim was to examine effects of treatments on: 1) age at maturity; and 2) stage-dependent variation. Potential importance of pedigree was also tested by comparing offspring from different females. Individual nauplii from egg-bearing females (8 randomly picked individuals per females’ clutch) were incubated individually and exposed to one of the four treatments: control, kairomone, copper or kairomone + copper. The experiment ran for 13 days (313 hours) with daily exchange of exposure solutions and simultaneous registration of survival (activity) and development (counting shed exuviae). Food (Rhoddomonas salina) was added daily ad libitum. All individuals in control were mature by the end of the experiment. A
2-parametric non-linear mixed effect model was used to describe nauplii development over time \((Instar = K/(1 + (K - 1) * exp(- (exp(log(mw) + age 1))))\), where \(K\) is the asymptotic development stage and \(mw\) is the average stage transition rate). Effects of treatment and pedigree on the two model parameters were examined by comparison of models with likelihood ratio tests and Akaike’s Information Criterion (AIC). This analysis finds that treatment influenced developmental stage at the beginning of the experiment, while pedigree affected the time to reach it. Developmental effects were found between the same mode of action in communities where developmental stages of surviving individuals. When all individuals in control had reached maturity (288 hours), individuals exposed to the combined treatment kaione + copper were significantly delayed compared to all other treatments.

Effects on individuals in the combined treatment were greater than expected based on the two treatments alone. A composite effect on development was already evident at the time of the first emerging copepodes (138 hours). These results indicate a synergistic relationship between risk of predation and copper by increased age at maturity in developing individuals of \(T. brevicornis\). The results also show the significant role of pedigree in determining development rate. This highlights the need to consider both natural stressors and individual heterogeneity when conducting ecotoxicological studies.

WE332 Functional and structural soil-vegetation indicators of ecosystem functioning in metal-contaminated environments: a case study in SE Spain

J. Álvarez-Roldan, A. Peltalver Alcalá, M. Tercero Gómez, H. Concejo Alcaraz, O. Muñoz-Orozco. Escuela Técnica Superior de Ingeniería de la Universidad Politécnica de Cartagena / Ciencia y Tecnología Agraria; F. Jiménez-Cárceles, BIOCYMA, Consulting in Environment and Quality, S.L. Murcia, Spain.; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science; M. González-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM Functional and structural soil parameters of six environments defined by stages of vegetation development in areas affected by radiation and contamination were: A) Within the mine tailings: 1. Bare soil (S); 2. Small groups of Pinus halepensis trees (2-5) ≤≈2.5 m high, growing scattered (P); 3. Isolated P. halepensis trees >≈3 m high with shrubs and herbs under the canopy (P+MS); 4. Dense patches with several P. halepensis trees (>≈) >≈4 m high and shrubs and herbs under the canopy (P+MS); B) Outside the mine tailings: 5. Polluted forest with P. halepensis trees >≈5 m high and shrubs and herbs under the canopy (CF); F). Control mature forest not contaminated with P. halepensis trees >≈4 m high with shrubs and herbs under the canopy (CF). Ecological indices of vegetation were evaluated and soils analyzed for physical, chemical, and biological parameters. Soil temperature, feeding activity of invertebrates and decomposition were measured in situ. P+MS, P+MS and P showed the highest diversity of plant species and P the lowest. The organic C/N ratio was ≈20 in P+MS, DP+MS, PF and CF ≈13 in S and P, which was in accordance with larger accumulation of litter in the first four environments. Cation exchange capacity (CEC), an indicator of the buffer capacity of the soil and the stability of the organic matter, was largely higher in P+MS (>≈32) followed by PF (>≈20), P+MS and DP+MS (>≈12) and finally P and S (=5). Water soluble metals in soil samples were also quantified. An increase in the concentration of organic C and C from microbial biomass (indicator of micro-organisms population) followed the same pattern than CEC. Total metal(s) concentrations (mg kg⁻¹) widely varied within the tailings, without a clear pattern related with plant colonization (e.g. Pb: 5400-14600; Zn: 8600-18000; As: 200-1200). Water soluble metal(s) (μg kg⁻¹), the most toxic fraction, were largely higher in S (e.g. Pb:4650, Zn:210000). Tea bag leaching composition showed two different tendencies: DP+MS, P+MS and S had a higher weight loss than PF. CF and P. Feeding activity was (% of holes fed: CF): 42%, P 39%, S≈31%, P+MS≈21%, AF:8%, DP+MS≈7%. Total and soluble/available metals concentrations cannot be considered the only factors related with the activity of bio in polluted sites. Field studies including physical, chemical, and biological parameters must be considered together to obtain realistic information for understanding soil ecosystem functioning and recovering.

WE333 Effects of imidacloprid and a neonicotinoid mixture on aquatic invertebrate communities under Mediterranean conditions

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Neonicotinoids are a group of insecticides that are used worldwide in agriculture to control sucking and chewing insect pests. These insecticides target terrestrial and aquatic organisms. Furthermore, they are highly toxic, a factor of ~3, whereas the combination of nTiO₂ with increasing UV intensity (0.00 vs. 2.20 m2/nm²) in the aquatic plant duckweed (Lemna minor) using a combination of genic, functional and adverse toxicity endpoints. The results indicate that single γ-radiation reduced \(L. minor\) reproductive rate at a high dose (47.1 mGy/h, 7.9 Gy) after 7 days' exposure. At the cellular level, γ-radiation inhibited photosystem II (PS II) maximal efficiency (%Fv/Fm), oxidative phosphorylation (OXPHOS) and enhanced the non-photochemical quenching (NPQ), light-saturated PS II operating efficiency (%Fv'/Fm'), electron transport rate (ETR) and reactive oxygen species (ROS) formation. Single UVR caused similar effects as γ-radiation and additional morphological change (size and colony disconnection) in the plant. When exposed in combination, enhanced reproductive inhibition, OXPHOS reduction, PSI inhibition, NPQ and ROS formation were observed for the high γ-radiation dose (47.1 mGy/h). Antagonistic effects on %Fv/Fm', pigments content, photochemical quenching (qP) and ROS formation were observed at low to intermediate γ-radiation doses (13.2 and 20.3 mGy/h). Multidose interaction effects as UVR and additionally induced morphological change (size and colony disconnection) were studied in order to identify the most relevant toxic pathways being perturbed by the single and multiple stressors tested. Combine study with radiations and chemicals are currently on going.

WE335 Natural organic matter determines the potential of titanium dioxide nanoparticles to mitigate pesticide toxicity in presence of UV light

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In nature environment, aquatic biota is facing to the ionizing radiation emitted from natural stressors and individual heterogeneity when conducting ecotoxicological studies. The results also show the significant role of pedigree in determining development rate. This highlights the need to consider both natural stressors and individual heterogeneity when conducting ecotoxicological studies.
toxicity of Primicarb was reduced 1.7-fold with increasing UV (0.00 vs. 2.20-2.60 W/m²). In presence of NOM, Primicarb toxicity was generally decreased (up to 2.3-fold, e.g. 0.00 W UV/m²). Depending on pesticide type and factor combinations we observed both positive and negative effects of UV radiation on the toxicity of the selected pesticides. A general prediction on the combined effects of nTiO₂, NOM, and UV on the toxicity of pesticides seems currently difficult. Rather, physiochemical properties like pesticide structure, solubility, adsorbability seem to be crucial for the interaction with nTiO₂, NOM, and UV-A, and the ultimate pesticide toxicity.

WE336 Effects of inorganic sunscreen formulations on the algal symbionts of reef-building corals, Symbiodinium spp., and their combined toxicity with ocean warming

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Between 4,000 and 6,000 tons of sunscreens annually are washed from the skin by swimming and diving, and directed released into the water, posing a potential threat to coral reef ecosystems. Titanium dioxide nanoparticles (nTiO₂) are common UV filters in cosmetic products, and in typical sunscreen formulations they are dispersed in an oil phase, a mixture of emulsifiers and emollients which can reach up to 20% of the product content by weight. In order to assess the impact of inorganic sunscreen on corals’ endosymbiotic algae (Symbiodinium spp.), three nTiO₂ with different sizes and surface coatings were dispersed in an oil phase to mimick commercial available sunscreen formulations. Two Symbiodinium phylotypes, known for their different tolerance to environmental change and stress, were exposed to oil:nTiO₂ dispersions at both ambient temperature (26°C) and thermal stress condition (32°C). Growth rates, maximum photosynthetic activity and reactive oxygen species (ROS) production were evaluated. Symbiodinium spp. exposure to sunscreen showed negative effects on all endpoints studied, and the toxicity is enhanced with simultaneous heat stress. Results indicate toxicity is not dependent on the type of nanoparticle and is likely driven by the oil carrier, a major ingredient in all cosmetic sunscreens. Relased oil, and the nanoparticles in the oil droplets, accumulate in the water surface microlayer and sediments due to its lipophilic characteristics and resistance against photolysis, constituting a major risk to marine organisms. Corals rely on the photosynthetic provided by the endosymbiotic algae for their nutrition, and the production of excess ROS by Symbiodinium cells as a consequence of heat stress, is considered to be a trigger of coral bleaching (the loss of Symbiodinium from the coral host). The significant decrease of maximum photosynthetic activity at 32°C coupled with the algae growth decline, and dirrect released into the waters, posing a potential threat to coral reef ecosystems. The increased ROS production following sunscreen exposure, in addition to the reduction of photosynthetic activity, provide evidence that exposure to these types of sunscreens may exacerbate bleaching response in corals and pose a risk to coral reef ecosystems in a changing ocean.

WE337 Metallotelmiones as an indicator of metal exposure in a naturally mineral enriched aquatic environment

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The Marico River, the largest river system in South Africa, is relatively unaffected by anthropogenic activities. However, metal concentrations – mainly from natural sources – occasionally exceed environmental quality guidelines or toxic concentrations. Macroinvertebrates are capable to react to these metals through processes such as the induction of metallothioneins (MTs). The aims of this study were to determine whether the induction of MTs can be used as indicator of natural metal exposure in anthropogenically impacted systems and whether there are relationships between metal concentrations in water, sediment and macroinvertebrates and concomitant MT levels. This was done by sampling macroinvertebrates, water and sediment from eight sites in the Marico River and tributaries. Water and sediment samples were prepared and analysed with an ICP-OES to determine metal concentrations. Seven families including Notonectidae, Coenagrionidae, Atyidae, Libellulidae, Baetidae, Caenidae and Chironomidae were selected and digested for metal analyses. Four families including Gerridae, Aeshnidae, Atyidae and Coenagrionidae were also analysed to determine their MT concentration. To test for possible relationships between metal concentrations in the macroinvertebrate families, MTs and metal concentrations in the water and sediment, Spearman’s non-parametric correlation tests were done among sites. Positive correlations were found between metals in sediment and macroinvertebrates, while there were no correlations between metal concentrations in water and macroinvertebrates. Even in freshwater river systems with a relatively low human impact and no mining activities, a positive correlation existed between trace metal bioaccumulation (e.g. Ni, Pb, Zn) in macroinvertebrates and the induction of MTs. There were, however, no correlations between MTs and bioaccumulation of earth metals (e.g. Al, Fe, Mn, Ti). These data clearly demonstrate the application value of MTs as biomarkers for metal exposure in freshwater systems.

WE338 Mollusks as indicators of environmental pollution (case studies in marine mussel Mytilus galloprovincialis Lam. and terrestrial snail Bradybaena fruticum Mull.)

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Snails are widely used as sentinel species in marine and terrestrial biomonitoring. Their wide distribution in different biotopes, high sensitivity to pollution makes them good bioindicators in environmental quality assessment. The comparability of mollusks in pure and polluted sites was performed in field studies round Moscow Region and in Moscow city as well as for marine bioindication in a few locations round Sevastopol city. Cardiac activity registration in selected mollusks was carried out as a tool for measuring deterioration of general health of local biota in the sites of the concern. Methodology with standard testing of heart rate (HR) and HR variability using functional loads (short-term temperature, salinity change, some mechanical stimuli, etc.) were carried out. In land biodiagnostics a 3–4 years old genetically modified morphs of bush snails Bradybaena fruticum (Mull.) were used collected from Moscow city (Kartmazovo, Kuz’minki,Ismoilov Park) with respectively and annual average and maximum allowable concentrations. Pair comparison was done based on cardiac activity monitoring in monitored groups of snails under thermal treatment (20-50min, 50±0,5°C). It was revealed that snails of the same genotype (striped and without strips) from chemically polluted sites (Kartmazovo, Kuz’minki) differed in lower thermo resistance from those of the reference site. Cardiac activity was measurable in basic conditions in mollusks both in Moscow city, was performed in Sevastopol Bays using salinity change test. Possible links between chemical pollution by dioxin (in terrestrial snails) and heavy metals contents in mollusk’s tissues (in marine mussels) and peculiarities of HR recovery after thermal or salinity loads were discussed.

WE339 The effect of temperature on toxicity of cypermethrin on Daphnia magna

P.T. Kajukari, University of Helsinki / Department of Environmental Sciences; V. Juntilia, University of Helsinki / A. Rantalainen, University of Helsinki; O. Pentininen, University of Helsinki / Faculty of Biological and Environmental Sciences

Cypermethrin is an insecticide which European Parliament of the Council has classified as a priority substance in Directive 2013/39/EU in the field of Water Policy. The Annex II of the Water Policy sets the environmental quality standards (EQS) for the priority substances. Cypermethrin’s annual average and maximum allowable concentration in inland surface waters are 0.08 ng/L and 0.6 ng/L respectively and annual average and maximum allowable concentration in the marine waters are 0.008 ng/L and 0.06 ng/L respectively, one of the lowest annual average and maximum allowable concentrations in environmental quality standard. The abiotic stressor like the temperature can have an effect on toxicity of the chemical. Previous studies have shown that the temperature of the environment affect the toxicity of pesticides belonging to the pyrethroids which cypermethrin is part of. The 48 hour half maximal effective concentrations (EC50) and median effective time (ET50) values were tested with crustacean Daphnia magna immobilization at the temperatures 10°C, 16°C and 20°C in laboratory experiments. Cypermethrin was almost twice as toxic at 10°C (2.17 ± 0.20 µg/L) compared with 20°C (4.10 ± 0.30 µg/L). The EC50 value of 16°C was 2.64 ± 0.21 µg/L which was closer to EC50 value of 10°C than 20°C. The temperature had statistically significant effect in the EC50 experiment. The temperature did have a slight effect in the ET50 experiment. The ET50 value at 10°C was 30.60 ± 0.74 hours compared with 33.12 ± 0.79 and 32.86 ± 0.83 hours respectively at 16°C and 20°C. The only statistically significant difference between the temperatures was between 10°C and 16°C. The temperature dependent behavior of cypermethrin was not taken into account when the environmental quality standard for cypermethrin was set by European Union and the United States Environmental protection agency’s reregistration eligibility decision for cypermethrin. With pyrethroids deltamethrin and permethrin the Canadian guidelines do not take account effects of temperature. When guidelines and legislations are prepared to certain chemicals some abiotic factors like the temperature should be considered. Key to changing guidelines and legislation is to take account the possible effects of temperature in test standards.

WE340 Pattern oriented food web modelling of metal mesocosm datasets

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The risk assessment of metals has a long history and over time a large collection of
ecotoxicity data has been accumulated. The most informative tests performed for the ecological effects of toxicants are mesocosm studies: controlled experiments where the effects of toxicants on model communities are studied for extended periods of time. Mesocosm studies are cost- and labor-intensive but offer a unique insight into realistic ecological effects of toxicants: they address not only direct effects on sensitive species, but also indirect effects resulting from ecological interactions (e.g., competition, predation) between sensitive and less sensitive species. Typically, the effects occurring in mesocosmos studies are however complex and difficult to interpret. A study has been set up to investigate whether food web modelling can reveal additional patterns, trends, or interactions in existing copper and zinc mesocosm datasets. Pattern oriented food web modelling – an ecological modelling technique – is used to reveal the mechanisms underlying metal effects. With this method, multiple competitor patterns in the datasets will be identified and described. Models are then evaluated for their ability to reproduce these patterns. In the case of mesocosm studies, food web models can be applied to understand the mechanism behind observed patterns. A large diversity of food web models exists with large differences in their complexity and underlying theories. Food web models based on ordinary differential equations are relatively simple in structure while they can still account for the interactions between species in the food web. They are therefore ideally suited to study mesocosm data. Additionally, the effects of environmental parameters such as temperature and pH, often key determinants of metal toxicity, can be included. Finally, the potential Pathway of Effects – explaining how metal toxicity leads to the observed patterns – can be evaluated to identify the most important drivers of metal toxicity in the mesocosm food webs and derive community-based threshold levels.

**WE341 Bioaccumulation and physiological conditions in Ruditapes philippinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Catchment/Shell weight indices**

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*Ruditapes philippinarum* (Adams & Reeve, 1850) is a soft-bottom dweller bivalve commonly used in biomonitoring programs, especially in bioaccumulation assessment, owing to its high tolerance to toxic compounds. However, bioavailability and accumulation of contaminants in the soft tissue of molluscs could be affected by abiotic factors, such as food availability, pH and temperature, and also by biotic factors, such as the seasonal changes of flesh weight in mussels. In this context, some issues could arise especially when comparing different sites in a long-term biomonitoring with data obtained from different periods of the year. In this study, bioaccumulation of metals, Polycyclic Aromatic Hydrocarbons (PAHs) and Butyltins (BTs) in Manila clams was monitored twice a year, from November 2010 to June 2015, in order to assess impact of human activities on *R. philippinarum* population from the Vallona Lagoon, a transitional area located in the delta of the Po River (NE, ITALY) which is the largest and most important Italian watercourse and one of the main sources of contaminants to Adriatic environments. Although levels were quite consistent with those reported from other geographical areas with low to medium pollution, seasonal trends were showed for each contaminant with higher concentrations on autumn rather than on spring surveys. The physiological condition of clams was also examined through two indices (condition index and survival in air) and they both exhibited seasonal variations coincident with those recorded for chemical parameters of water (temperature, pH, salinity and dissolved oxygen) were also considered. To ensure that bioavailability assessment was not affected by seasonal variation of soft tissues of molluscs, Contaminant/shell weight indices, which consist of normalization achieved multiplying each contaminant concentrations by the condition index, were applied. Accordingly, the normalization enabled us to highlight the contaminant uptake from clams in some particular periods and to compare different sites in a long-term biomonitoring with data obtained from different periods of the year. Indeed, some contaminations showed quite a steady state all over the monitoring period and at the different sites, whilst others, such as Arsenic, Chrome, Nickel, Lead, Copper, Zinc and BTs, showed different patterns of bioaccumulation with some periods presenting enhanced concentrations probably related to anthropogenic activities.

**WE342 Biomonitoring of Singapore mangroves using biomarker expression and contaminant burden in caged green mussels, Perna viridis.**

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Mangroves are fragile coastal ecosystems whose ecological and socioeconomic importance for adjacent ecosystems and local populations is being clearly recognized nowadays. Mangroves are one of the most threatened tropical environments and our understanding of the impact of chemical pollution on these ecosystems is still at its infancy. In this study, nine mangroves sites were selected around Singapore coastline to cover various contamination profiles, and green mussels, *Perna viridis* were used as bioindicators. Bivalves were deployed in cages at each of the nine mangrove patches for 28 days on two consecutive years (one year during the monsoon period and the other year during a dry-weather period), and collected for subsequent analysis. A series of biochemical and cellular biomarkers were developed and measured using various organs. Metallothioneins (MTs), Glutathione-S-Transferase (GST), Ethoxyresorufin O-deethylase activity (EROD), Vitellogenin-like protein (VLP), an inhibitor of Acetylcholinesterase (AchE) were measured in the bivalves’ digestive tissue. Mussel’s haemolymph was also used to evaluate various immunological parameters (Total Haemocyte counts, phagocytosis and lysozyme levels) and the level of haemocytes’ DNA damage, using the Comet assay. Results of this study revealed different profiles of biomarker expression between the various sites. Most notably, metallothionein induction was observed at some the sites, indicating potential exposure to heavy metals while higher levels of DNA damage and EROD were also recorded at some of the mangrove patches pointing towards possible exposure to organic contaminants. Some biomarkers appeared to be subject to seasonal variations while others were very stable. Possible correlation between biomarker expression and the level of various contaminants (metals, PAHs, pharmaceuticals, endocrine disruptive chemicals, personal care products) in caged mussels were also studied. Using an Integrated Biomarker response index, the various mangrove sites were eventually ranked amongst each other. Our findings ultimately indicated a clear segregation of mangrove sites, indicating that some mangrove patches were potentially more at risk than others towards chemical contamination.

**WE343 Impacts of climate change on mercury bioaccumulation in large ocean predators**

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Many marine ecosystems are being affected by climate driven changes in freshwater discharge, circulation, productivity and seawater temperature. Large ocean predators such as tunas account for a large proportion of methylmercury exposure in many countries (almost 40% of U.S. population wide intake between 2010-2012). Methylmercury is a potent neurotoxicant, particularly for children, and has been associated with impaired cardiovascular health in adults. We have developed a new mechanistic model for methylmercury bioaccumulation in marine food webs (BAM). The model is driven by methylmercury concentrations in seawater and ocean biogeochemical conditions (temperature, dissolved organic carbon (DOC), and trophic status). Here we apply this model to investigate the magnitude of changes in methylmercury concentrations expected from decadal oscillations in seawater temperature in the North Atlantic. We compare the magnitude of these changes to those occurring in the Pacific Ocean and discuss how climate related variability is likely to affects exposures of humans and wildlife to methylmercury. Our results suggest changes in tissue burdens driven by oscillations in seawater temperature are similar in magnitude to those that have been achieved by reductions in emissions in the North Atlantic.

**WE344 Chemical stress on aquatic communities under semi-arid conditions: towards an improved multimetric approach**


Combined effects of chemical pollution and water scarcity are one of the most important threats to aquatic ecosystems in (semi-)arid regions of the world. The low dilution potential of chemicals (urban, industrial and agricultural) discharged in aquatic ecosystems under water scarcity conditions could lead to devastating toxic effects. Moreover, a large proportion of aquatic bodies in these regions are known to have a high hydrological variability in a temporal scale. In this sense, communities naturally adapted to this condition are expected to respond differently to chemical stress than those adapted to more constant water flows. The aim of this study was to evaluate the combined effects of multiple stressors on aquatic ecosystems in scenarios that are characteristic of (semi-)arid regions. In particular, this study focused on identifying the main stress factors that are influencing aquatic communities in the semi-arid region of Madrid (central Spain). Sixteen sites were selected in the watershed of the Tagus River (Madrid, Spain) and sampled in three consecutive years (spring, summer and fall). Hydrological and physico-chemical parameters of aquatic ecosystems were monitored, together with concentrations of metals and organic contaminants (pharmaceuticals, home-care products, pesticides). With respect to organic contaminants, the results from a screening analysis revealed the presence, at detectable levels, of 100 compounds in water samples. A group of 42 contaminants were selected for quantification and also by biotic factors, such as the seasonal changes of flesh weight in molluscs. Arid conditions: towards an improved multimetric approach. We compare the magnitude of these changes to those occurring in the Pacific Ocean and discuss how climate related variability is likely to affects exposures of humans and wildlife to methylmercury. Our results suggest changes in tissue burdens driven by oscillations in seawater temperature are similar in magnitude to those that have been achieved by reductions in emissions in the North Atlantic.

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a temporal and spatial scale were evaluated at a taxonomic and at a biological trait level. Significant responses to multiple stressors from some invertebrate taxa and functional traits (feeding habits, reproduction and respiration) were determined. Based on these results, suggestions for a biological vulnerability multitemric index, which considers more site-specific conditions, will be presented.

WE345 Long-term effects on transplanted caged-freshwater bivalves Diplodon chilenis to the assessment of water quality in a Patagonian river M.S. Yusseppane, Facultad de Ciencias Exactas y Naturales Universidad de Buenos Aires / Department of Biochemistry, IQUIBICEN-CONICET, FCEN-UBA; S.E. Sabatini, IQUIBICEN CONICET Universidad de Buenos Aires / Department of Geology, A.B. Siu, Facultad de Ciencias Exactas y Naturales Universidad Nacional del Comahue, Neuquén / INIBIOMA-CONICET, C.M. Castro, INIBIOMA CONICET / Laboratorio de Ecotoxicología Acuática INIBIOMA; C.M. Luquet, CONICET / Laboratorio de Acuatic Ecology, INIBIOMA; I. Rocchetta, IQUIBICEN CONICET Universidad de Buenos Aires / Department of Chemistry Biochemistry, M.D. Rios de Molina, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica, CONICET-UBA, Instituto de Química Biológica - Ciencias Exactas y Naturales (IQUIBICEN)

Population growth and human activity are contributing to habitat deterioration in Patagonian rivers with the consequent threat to water quality and biodiversity. The bivalve *Diplodon chilenis* is a key species in the macroinvertebrate fauna of Patagonian lakes and rivers which has been proposed as a sentinel organism in the area. We evaluated the long-term effects of transplantations of caged *D. chilenis* to different sites in the Chimehuin river (reference site (S1), downstream from an aquaculture facility (S2), and downstream from an open dump and from the sewage treatment plant (S3)) after 3, 6, 9 and 12 months of exposure. We combined the antioxidant response, oxidative damage, ROS production and energetic status, with water and sediment analysis (physico-chemical and biological variables, and organic matter content). Physico-chemical variables varied according to site and time of exposure. Sites S2 and S3 showed generally higher chlorophyll a concentration and total colloform bacteria values compared to site S1, whereas organic matter content in the sediment was elevated only at site S2. In *D. chilenis*, gill SOD and GST activity was higher in both S2 and S3 than in S1 by the end of the exposure time. During the last month of exposure (month 12), GSH levels dropped dramatically in individuals from S2 and S3 sites.

Gutto gland factor (GDF) and energy values in digest gland were increased at sites S2 and S3, from 6 to 9 months of exposure. Our results indicate that despite the large flow rate of Chimehuin river water quality is deteriorated in areas impacted by anthropogenic activities (aquaculture, solid waste disposal and sewage). This effect is reflected by a physiological response of *D. chilenis*, which is especially significant during period of their highest metabolic activity (austral fall/ winter).

WE346 The influence of selected seasonal and anthropogenic phenomena on a perennial river in South Africa.

G. Van Niekerk, North West University (Potchefstroom Campus) / Zoology-School of Biological Sciences; C. Wolmarans, H. Pienaar, North-West University - School of Biological Sciences / Zoology

The quality of surface waters worldwide is declining fast. This is due to anthropogenic impacts, such as land use change and natural occurring floods and droughts which are predominant abiotic agents of disturbance in intermittent streams. The objective of this study was to establish whether seasonal fluctuations can reduce the effect of anthropogenic impacts on the river and whether this is reflected by macroinvertebrate assemblages, physico-chemical water parameters and metal concentrations in the water and sediment. Water quality and macroinvertebrate community data were collected in the Crocodile River (South Africa). Four surveys were conducted, two during the low-flow and two during the high-flow season. Spatial and temporal variations were found with regard to suspended solids and total organic material. The low flow surveys had a slight increase in suspended solids and total organic material, whereas a substantial increase occurred during the high-flow season. The highest concentrations of metals in the water column were in contrast to the sediment concentrations observed during the high-flow seasons at the majority of the sites. Only minor differences in sediment metal concentrations were noted between high and low flow seasons. The pH values increased from the origin of the river downstream. However this did not result in a clear trend with regard to either an increase in sediment metals or a decrease in the concentration of dissolved metals (Control, Low and High Concentration) in each environmental scenario. The insecticide was applied twice, with a 10 day interval between applications. Test units without desiccation were refilled twice per week with distilled water. Test units exposed to drought stress were not refilled and allowed to desiccate. After that, these units were refilled up to the initial level and maintained for two more weeks. Lufenuron concentrations in water and sediments were periodically measured, together with water quality parameters (DO, pH, T, EC and nutrients). Zooplankton composition was determined on a weekly basis, and the isolated and interactive effects of temperature, drought and lufenuron were evaluated using suitable statistical techniques. Effects were assessed at the community and at the

WE347 Growth, Photosynthetic and Antioxidative Defense System Response of Hordeum vulgare to Combined Stress of Heat and Drought A. Diksaityte, Vytautos Magnus University; R. Dagiltiene, Vytautos Magnus University / Environment Science Department; L. Kubile, D. Milkeleyte, G. Juozapaitiene, Vytautos Magnus University

Extreme climatic events such as heat waves and drought periods are predicted to increase in frequency and severity in many regions under future climate scenarios, and in natural environment these two abiotic stresses often occur simultaneously. The short-term (3 day-long) impact of +10 °C heat wave treatment 6.5 h per day was investigated on *Hordeum vulgare* under well-watered and water deficit conditions in Closed-top chambers under controlled environment. The decreases in shoots dry weight, shoots length and leaves area were observed in the water deficit treatment after exposure to heat wave, while all these parameters in the well-watered treatment were not affected significantly. The decline in shoots dry weight and leaf area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed *Hordeum vulgare* plants suffered markedly stronger physiological and oxidative stress caused by the combination of heat stress and drought stress. Our results also revealed an important of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

WE348 Does elevated CO2 protects plants against heat waves damage? J. Zaltauskaitė, Vytautos Magnus University / Department of Environmental Sciences; G. Sujovienė, V. Januškaitienė, A. Diksaityte, D. Miškelytė, G. Juozapaitienė, R. Juknyš, Vytautos Magnus University

The frequency and severity of heat waves is increasing as a result of climate change. Therefore, extreme events may impact the growth of crops and weeds to heat waves and CO2 may also cause shifts in their competitive interactions. The aim of the study was to examine the influence of extreme events (heat wave plus drought) and CO2 on the growth of spring barley (*Hordeum vulgare* L.) and wild mustard (*Sinapis arvensis* L.). Barley and wild mustard, growing together in the microcosms at the combination 2:1, were subjected to short-term processes and were in control wereir (5% CO2 35% air) or water deficit treatment after one day regeneration period. In contrast, neither shoots dry weight nor leaves area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed *Hordeum vulgare* plants suffered markedly stronger physiological and oxidative stress caused by the combination of heat stress and drought stress. Our results also revealed an important of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

WE349 Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities: a microcosm study.

A.A. Sanchez, IMDEA Water Institute / Aquatic Ecotoxicology; I. López, L. Nozal, IMDEA Water Institute; M. Vigo, IMDEA Water Institute / Earth and Environmental Sciences; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology Water scarcity and chemical pollution are two of the main groups of stressors causing ecological impairment in freshwater aquatic ecosystems of (semi-)arid regions. Predictions about human and climatic pressure on water resources in these regions reveal that the interaction between these two groups of stressors will increase in the nearby future. In line with that, advances in ecological risk assessment recognise that stress factors harming aquatic ecosystems rarely operate individually. Therefore, new approaches to assess interactions between multiple stressors are needed. In this study we evaluated the combined effects of the insecticide lufenuron and two additional stress factors: increasing water temperatures and drought stress. Twenty-seven microcosms were stocked with pond water, sediment, and a homogeneous plankton assemblage. Three environmental scenarios were simulated: 20°C and 28°C without desiccation, and 28°C with desiccation. The experiment was performed in triplicate with three insecticide concentrations (Control, Low and High Concentration) in each environmental scenario. The insecticide was applied twice, with a 10 day interval between applications. Test units without desiccation were refilled twice per week with distilled water. Test units exposed to drought stress were not refilled and allowed to desiccate. After that, these units were refilled up to the initial level and maintained for two more weeks. Lufenuron concentrations in water and sediments were periodically measured, together with water quality parameters (DO, pH, T, EC and nutrients). Zooplankton composition was determined on a weekly basis, and the isolated and interactive effects of temperature, drought and lufenuron were evaluated using suitable statistical techniques. Effects were assessed at the community and at the
population level. Lufenuron was the main stressor in all the environmental scenarios, with a significant decrease of Cladocera and Copepoda, and an increase of Rotifera. Temperature and drought had slight effects on community composition and accelerated insecticide dissipation, influencing community recovery capacity. Interaction between factors at community and population level was mainly observed at the beginning of the experiment. Direct and indirect responses at population level varied between environmental scenarios. The results of this study contribute to understand differences in vulnerability of aquatic ecosystems to multiple stressors in (semi-)arid regions.

WE350 Toxicity of phenoxy herbicide: the effects of elevated temperature and CO2 concentration
J. Zaltanskaite, Vytautas Magnus University / Department of Environmental Sciences; G. Sujetoiene, A. Diksaityte, J. Januskaitiene, G. Kaciene, G. Juozapaitiene, D. Miskelyte, Vytautas Magnus University; S. Sakalauskienie, J. Miliauskienie, Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry; R. Juknas, Vytautas Magnus University
Climate change is a major concern for agriculture and crop productivity. Crop productivity strongly depends on crop protection measures such as use of herbicides. Climate change will influence the fate and ecotoxicity of herbicides by altering their environmental partitioning and degradation, distribution and abundance of weeds and growth and development of weeds and crops. Differential responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the crop-weed interaction. The aim of the study was to assess the influence of elevated temperature and CO2 on the effects of phenoxy herbicide to spring barley (Hordeum vulgare L.) and common lambsquarters (Chenopodium album L.). Two climate scenarios were investigated: current climate (21 °C, 400 ppm CO2) and future climate (25 °C, 800 ppm CO2). The terrestrial target Ch. album and non-target H. vulgare plants, growing together in the microcosms at the combination 2:1, were sprayed with herbicide sprays solutions equivalent to 0.5-2 of field application rate. The plants were sprayed at the four-to-five leaf stage with herbicide solutions prepared with 4-Chloro-2-methylphenoxyacetic acid (MCPA, CAS No. 94-74-6, Sigma-Aldrich). The growth and response of antioxidative defence system of both species were evaluated.

WE351 Combined effects of insecticide exposure and predation risk on freshwater detritivores
A. Rodrigues, University of Aveiro / Biology Department and CESAM; M.D. Bordalo, University of Aveiro; O. Golovko, O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrogenocenes; C. Barata, CSIC / Environmental Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; J. Pestana, CESAM & University of Aveiro / Biology
Exposure to sub-lethal concentrations of insecticides are known to pose at risk non-target insects due to effects on physiology and behaviour. Under natural conditions, there may be a high sensitivity of natural stressors, such as predation. Perception of predation risk alone may change the behaviour and physiology of prey species, impacting their fitness and, thus, their susceptibility to chemical exposure. There are thus growing efforts to understand how the combined effects of toxicants and biotic stressors may affect populations, food web dynamics and ecosystem functioning. Chlorantraniliprole (Cp) is a neonicotinoid insecticide used in agriculture as a model compound to test the effects of phenoxy herbicide to spring barley and to investigate the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the combined effects of insecticide exposure and predation risk on freshwater detritivores we studied the combined effects of insecticide exposure under predation risk on freshwater detritivores. The combined effects of insecticide exposure under predation risk on freshwater detritivores and the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the combined effects of insecticide exposure under predation risk on freshwater detritivores.

WE352 How sugarcane and high temperatures are contributing to amphibian declines in Brazil? Morphological, biochemical and molecular approaches
J. Freitas, University of Sao Paulo - USP / Department of Hydraulic and Sanitation; E.A. de Almeida, Fundação Universidade Regional de Blumenau; D. Schlenc, University of California-Riverside / Department of Environmental Sciences; E. Espindola, University of Sao Paulo USP / Hydraulics and Sanitation
Sugarcane is the most efficient first-generation source of ethanol in the market, which has contributed to the rapid expansion of its crops and generated concerns related to its environmental impacts to Brazilian territory. In tropical areas, agricultural activities of sugarcane are intensified during the rainy season, which coincides with the period of occurrence for amphibian species. Tadpoles and other aquatic animals from tropical areas of the world also experience large temperature fluctuations in their habitats. So, there is a great concern that amphibians are not only being affected by pesticides in their environments, but also by the combined effects of pesticides and temperature changes. In this study, we evaluated biochemical, morphological and molecular effects caused by the exposure to herbicides used on sugarcane crops in Brazil (diuron and its metabolite, 3,4-DCA, clomazone and sulfonylurea) on tadpoles of different species, using different thermal gradients. Our results showed that temperature is an important factor influencing the toxicity of pesticides in tadpoles. Diuron combined to higher temperatures accelerated metamorphosis process in tadpoles of Lithobates catesbeianus. Temperature and metamorphosis genes expression (dio2, dio3, thio, tra, tfβ and klf9) were mostly upregulated in these groups, showing disrupting effects of diuron for amphibians. 3,4-DCA presented similar responses to diuron on L. catesbeianus and its effects were also pronounced at high temperatures. Native tadpoles of Rhinella schneideri and Euphengis nattereri had their antioxidant defense system affected by exposure to the herbicides clomazone (Clomazone) and sulfonylurea. Sulfate beta-adrenergic receptor antagonist (SOD, CAT, G6PDH) and biotransformation enzymes activities and induced lipid peroxidation with temperature associated responses in tadpoles of both species. Clomazone also increase carboxylase activities in tadpoles exposed at higher temperatures. Integrated Biomarker responses (IBR) index showed a synergic effect of temperature and sulfentrazone or clomazone in R. schneideri and E. nattereri. Our results contribute to understand the effects of herbicides in tadpoles, and its effects can be pronounced at higher temperatures. These findings imply that the effects of abiotic factors should be taken into account to evaluate the real risks of exposure of amphibians to commonly used pesticides, mainly in tropical areas.

WE353 Adaptation vs. acclimation of natural phytoplankton communities towards herbicide exposure
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Freshwater ecosystems are subject to natural and anthropogenic disturbances such as climate change, landscape management, natural resources overexploitation and also pollution. Chronic background contamination by pesticides applied in agriculture poses a selective pressure on natural phytoplankton communities, favouring species and strains that can handle herbicide exposure better than others. In the current study, we investigated if exposure to a herbicide (Clomazone) will influence the fate and ecotoxicity of herbicides by altering their environmental partitioning and degradation, distribution and abundance of weeds and growth and development of weeds and crops. Differential responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the crop-weed interaction. The aim of the study was to assess the influence of elevated temperature and CO2 on the effects of phenoxy herbicide to spring barley (Hordeum vulgare L.) and common lambsquarters (Chenopodium album L.). Two climate scenarios were investigated: current climate (21 °C, 400 ppm CO2) and future climate (25 °C, 800 ppm CO2). The terrestrial target Ch. album and non-target H. vulgare plants, growing together in the microcosms at the combination 2:1, were sprayed with herbicide sprays solutions equivalent to 0.5-2 of field application rate. The plants were sprayed at the four-to-five leaf stage with herbicide solutions prepared with 4-Chloro-2-methylphenoxyacetic acid (MCPA, CAS No. 94-74-6, Sigma-Aldrich). The growth and response of antioxidative defence system of both species were evaluated.

WE354 Impacts of climate change on freshwater pesticide exposure
T. Sinclair, University of Sheffield / Animal and Plant Sciences; A. Boxall, University of York / Environment Department; L. Maltby, The University of Sheffield / Dept. of Animal & Plant Sciences; S. Beule, Envirosense / Food and Environmental Safety Programme; R. Williams, Centre for Ecology & Hydrology
Climate change will modify environmental conditions which will likely have knock-on effects on the usage and environmental fate and behaviour of active
Effects of water browning on zooplankton physiology and fitness driven by GST activity were slightly elevated. NOEL were determined to be 24.8°C and 12°C, respectively. Levels of ROS and in response to temperature increase of 2°C per day. In temperate copepod _T. kingsejongensis_, hsp responses peaked after addition of the tDOC. In the first week of exposure, daphnids experienced oxidative stress, i.e. an imbalance in favor of oxidative damage, but followed after addition of the tDOC. In the first week of exposure, daphnids were exposed to a standard source of terrestrial-derived dissolved organic carbon (tDOC) that causes browning of lakes and streams, but long-term effects of tDOC on freshwater organisms are not sufficiently known. Using a combination of an in situ enclosure experiment and laboratory incubations, we tested whether long-term tDOC exposure affects the physiology and life-history traits of the water flea _Daphnia longispina_, and whether any observed effects are reversible. Daphnids were collected from a long-term, large-scale enclosure experiment conducted in a clear-water lake in northeastern Germany, where a natural plankton community was exposed to a standard source of tDOC (HuminFeed®). The physiological state of daphnids in the enclosures was followed after addition of the tDOC. In the first week of exposure, daphnids experienced oxidative stress, i.e. an imbalance in favor of oxidative damage, but this response was no longer observed after 36 days. Daphnids and water from the enclosures sampled again after 10 weeks were used to assess survival and reproductive performance under laboratory conditions. Both survival and reproduction were related to sex traits and other chemical properties and uses, were modelled in streams in the UK using two models recommended by the Forum for the Co-ordination of Pesticide Fate Models and their Use, namely MACRO and PRZM. Model predictions were obtained for current conditions and for expected conditions in the 2080s by parameterising the models for current and future predicted weather conditions, cropping patterns, soil properties and pesticide use patterns. The results show that exposure patterns of APIs are likely to change in the future. These changes in exposure vary by pesticide type and the region modelled with exposure in some chemical-region combinations increasing and in others decreasing.

WE355
Ranking micropollutants in effluent by exposure indices evaluated via suspect/nontarget screening
P. Narae, Changwon National University / Environmental Engineering; c. younghun, Changwon National University / FEED of Eco-Friendly Offshore Structure; J. Jeon, Changwon National University / Environmental Engineering
Information on the occurrence and concentration of micropollutants in effluents from wastewater treatment plants (WWTPs) provides important clues for evaluating the risk and availability of river ecosystems. However, the chemical monitoring work for the numerous trace contaminants is time-consuming, labor-intensive, and cost a lot. To overcome the problems, the effluent monitoring programs have been conducted for limited, but prioritized pollutants. In general, the prioritization has been mainly based on effect/toxicity information rather than exposure relevancies. Thus, for risk assessment in WWTPs with high occurrence frequency and concentration have often been underestimated when their effect/toxicity are neither considerable nor well defined. In the present study, a list of prior effluent micropollutants is suggested with a exposure-index based scoring/ranking procedure following qualitative chemical analysis. A scoring table with exposure indexes such as occurrence frequency and chromatographic peak area was applied for the ranking. WWTP effluent samples were taken in September, 2016 and analyzed via suspect/nontarget screening using LC-HRMS (QExactive® Orbitrap). Within a suspect list, about 60 compounds were tentatively identified and ranked by the score. After purchasing reference standards for high rankers, about 20 micropollutants were orthogonally confirmed and roughly quantified. The prioritized micropollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatory (acetylsalicylic acid, mefenamic acid), antibiotics/antifungal (clindamycin, fluconazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbazamepine-epoxide, oxcarbazepine), antihistamines (diphenhydramine, fexofenadine), antihypertensive agent (ibesartan, valsartan), antipsychotics (haloperidol), anti-inflammatory (naproxen, ibuprofen) and other micropollutants. The concentrations for the top ranker, acetaminophen detected in all 7 samples, was ranged up to 1,300 ng/L. The 2nd ranking pollutant was caffeine and followed by ketocidiné> mefenamic acid>fexofenadine> carbamazepine>ibesartan> fluconazole> dephthydramine> sulfamethoxazole. Since some tentatively identified pollutants were left unconfirmed, the prioritized compound list should be updated along with additional confirmations. Nevertheless the ranked list still include highly exposable micropollutants which are worthy for intensive monitoring in effluents.

WE356
Interspecific effects of temperature shifts on life parameters, oxidative stress, and exposure of fatty acid synthesis genes and heat shock protein genes in two coenogenic copepods _Tigriopus sp._
J. Hau, Sungkyunkwan University / Biological Science; J. Lee, Sungkyunkwan University
In this study, we compared the effects of temperature changes on lifecycle parameters, intracellular reactive oxygen species (ROS) levels, glutathione-S-transferase (GST) enzymatic activity, and gene expression profiles of both the _de novo_ lipogenesis (DNL) pathway and heat shock protein (hsp) genes in the temperate copepod _Tigriopus japonicus_ and the Antarctic copepod _Tigriopus kingsejongensis_. The median lethal temperature (LT50) and no observed effect level (NOEL) in _T. japonicus_ were determined to be 35.3°C and 32°C, respectively, in terms of temperature increase of 2°C per day. In _T. kingsejongensis_, LT50 and NOEL were determined to be 28.4°C and 12°C, respectively. Levels of ROS and GST activity were slightly elevated (<em>P</em> 0.01).

WE357
Effects of water browning on zooplankton physiology and fitness driven by functional characteristics in a long-term enclosure experiment
L. Minguez, LIECN (CNRS UMR 7360, Université de Lorraine) / Laboratoire Interdisciplinaire des Environnements Continentaux, CNRS UMR 7360; E. Sperfeld, University of Oslo / Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences; S.A. Berger, J.C. Nejstgaard, Leibniz Institute of Freshwater Ecology and Inland Fisheries / Dept. Experimental Limnology; M.O. Gessner, Leibniz Institute of Freshwater Ecology and Inland Fisheries
ECotoxicological assays using _Daphnia_ species are generally performed under optimal food and light conditions. However, results of such assays may not adequately reflect stress responses in the wild, since the ability of organisms to cope with adverse conditions critically depends on the amount of available energy. One type of potential stressors that could be experimentally implemented in mesocosm experiments is terrestrial-derived dissolved organic carbon (tDOC) that causes browning of lakes and streams, but long-term effects of tDOC on freshwater organisms are not sufficiently known. Using a combination of an in situ enclosure experiment and laboratory incubations, we tested whether long-term tDOC exposure affects the physiology and life-history traits of the water flea _Daphnia longispina_, and whether any observed effects are reversible. Daphnids were collected from a long-term, large-scale enclosure experiment conducted in a clear-water lake in northeastern Germany, where a natural plankton community was exposed to a standard source of tDOC (HuminFeed®). The physiological state of daphnids in the enclosures was followed after addition of the tDOC. In the first week of exposure, daphnids experienced oxidative stress, i.e. an imbalance in favor of oxidative damage, but this response was no longer observed after 36 days. Daphnids and water from the enclosures sampled again after 10 weeks were used to assess survival and reproductive performance under laboratory conditions. Both survival and reproduction were related to sex traits and other chemical properties and uses, were modelled in streams in the UK using two models recommended by the Forum for the Co-ordination of Pesticide Fate Models and their Use, namely MACRO and PRZM. Model predictions were obtained for current conditions and for expected conditions in the 2080s by parameterising the models for current and future predicted weather conditions, cropping patterns, soil properties and pesticide use patterns. The results show that exposure patterns of APIs are likely to change in the future. These changes in exposure vary by pesticide type and the region modelled with exposure in some chemical-region combinations increasing and in others decreasing.

WE358
Interactive effects of multiple stressors on estuarine processes
A. O'Brien, The University of Melbourne; K. Dafforn, Macquarie University / Evolution and Ecology Research Centre; M. Mayer, University of New South Wales / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre; A. Chariton, Macquarie University / Molecular Ecology and Toxicology
Natural systems are threatened by a variety of different anthropogenic stressors. These are often considered in isolation, but in reality most are found in combination and have the potential to interact with different outcomes. Urban systems such as estuaries and harbours are commonly exposed to chemical (e.g. contaminants), physical (e.g. built infrastructure) and biological (e.g. invasive species) stressors. It is important to understand the interactive threats posed by these stressors. Here we use a systematic literature review to explore selected urban stressors and their potential interactions under current environmental conditions. We link the interactive effects responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are common across systems, we link the potential to identify important patterns and trends. This allows us to go beyond comparisons that rely on community structural endpoints and are potentially only relevant at local scales.

WE359
Ecology or reproducibility crisis? - Lessons from a laboratory scale tri-trophic test system
V. Riedl, Environment Department, University of York / Environment Department; A. Agatzi, IBACON GmbH / Environment Department; R. Benstead, Fera Science Ltd / Centre for Chemical Safety and Stewardship; R. Ashauer, University of York / Environment
Concerns, some of which have been raised regarding a lack of reproducibility in scientific research. There is indeed evidence that a number of research findings are not reproducible by others or even within the original laboratories. Yet, while the reproducibility of results might often be difficult, it is essential in the context of regulatory decision making. In the environmental risk assessment of pesticides, for instance, replication, standardization and reproducibility are of great importance to determine the potential risks. The lack of reproducibility is linked to various factors including the test system, test conditions, exposure duration and post exposure conditions. Here, we present a systematic literature review to explore selected urban stressors and their potential interactions under current environmental conditions. We link the interactive effects responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are common across systems, we link the potential to identify important patterns and trends. This allows us to go beyond comparisons that rely on community structural endpoints and are potentially only relevant at local scales.
TriCosm (P. subcapitata, Ceriodaphnia, Hydra) was developed as an intermediate link between simple single-species tests and complex multi-species systems, to detect small stressor-induced alterations in ecological interactions. The achievement of standardization, replication and reproducibility was given close attention during the development of the system, yet, the TriCosm was found to be compliant in terms of repeatability and reproducibility only in the short term. Here we present experiments designed to discern effects of variation due to ecologically interesting factors that impact on the community dynamics in this aquatic multi-species system.

WE360 Improving tolerance to natural and chemical stressors by inducing early life stages in the rotifer Brachionus sp. Cayman.

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Rotifiers are widely used as bio-indicators and models for ecotoxicology due to characteristics such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larve in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this work was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural and/or chemical stressors in life. Acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cayman (MRS10 and IB3), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artemia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25°C and 25 pu as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0–4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed. Sensitivity values compared. Results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an aquaculture context could be advantageous to decrease the mass mortality in rotifer production. Future research within this project will address possible epigenetic mechanisms (DNA methylation or histone modifications) behind those genetic changes and assess if their maintenance can be achieved through several generations.

WE361 Effects of a mixture of pharmaceuticals in a freshwater model ecosystem

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Owing to their ecological importance, freshwaters provide important services such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larve in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this work was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural and/or chemical stressors in life. Acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cayman (MRS10 and IB3), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artemia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25°C and 25 pu as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0–4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed. Sensitivity values compared. Results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an aquaculture context could be advantageous to decrease the mass mortality in rotifer production. Future research within this project will address possible epigenetic mechanisms (DNA methylation or histone modifications) behind those genetic changes and assess if their maintenance can be achieved through several generations.
WE366 Effects on NTA communities: HCx vs NOEC designs
F.M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation
We discuss two examples of field fauna study designs with non-target arthropods (NTA). In both cases a hay meadow was chosen as a paradigm representative for off-field habitats at risk. One example concerns an HC, approach where EC, for various x were estimated from a field experiment and used to derive a Species Sensitivity Distribution. The other example concerns a more “classical” approach where a limited number of rates was tested in a replicated block design and the NOEC endpoint was found via statistical hypothesis testing. The merits and caveats of both approaches will be discussed and a protocol for evaluating and documenting statistical and biological significance of a NOEC study design will be presented. We analyse whether “No Effects” may have statistical or biological causes. In the HC-study consistent dose-response curves were obtained within 4 major arthropod taxa 63 out of 776; 8%) and SSD’s could be constructed for each of them. Due to full overlap of curves the classes could be combined, resulting in narrow confidence intervals. In the NOEC-study 66 from 596 (11%) taxa were valid for univariate analysis, representing all major taxa. The protocol developed for the classification of results yielded an informative evaluation and allowed results to be classified as inconclusive or conclusive on a confidence scale of 1-4. Both study designs were fit for purpose and both are biologically and statistically valid. Where the HCx-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, where the regulatory implication of the NOEC is clear, the methodological issues related to hypothesis testing hamper a clear-cut presentation. An evaluation summary table, involving MSD-analysis, as presented here may be helpful in this regard.

WE367 a-Dominance versus β-Prominence
F.M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation
The NOEC or an equivalent regulatory set ECx*, value are key endpoints to assess safety of pesticides. A new challenge has been introduced when a test is carried out in a multispecies context, e.g. in non-target arthropod (NTA) field studies. To date most ecotoxicological faunistic NTA field studies follow a hypothesis test design. Few examples can be found that address ECx* finding by extrapolation from a regression model, such as the SSD-curve. There are two risks associated with hypothesis tests: the producers’ risk and the consumers’ risk. The alpha level and Type-II error that is known as the power of an experiment. We show how power criteria can be derived and used to construct a biology based confidence profile for studies addressing NTA communities. We also show how relaxing α helps to identify those taxa for which an experiment does not provide sufficient conclusive data to draw meaningful conclusions. In a multi-rate study design, the proposed increase of α to 10% is shown to be off-set by applying expert criteria such as inconsistencies or dose in time. 

WE368 Defining simple toxicity values (EC, BMD) is not so simple
E. Billiet, Université de Lorraine, CNRS UMR 7360; F. Latras, Helmholtz Center for Environmental Research - UFZ GmbH; V. BAILLARD, LIEC (CNRS UMR 7360, Université de Lorraine); S. Devin, LIEC. CNRS UMR 7360, Université de Lorraine / LIEC, CNRS, M. Schmitt-Jansen, UFZ - Helmholtz Ctre Environm. Research / Department of Bioanalytical Ecotoxicology; M. Delignette-Muller, VetAgro Sup / Laboratory of Biometry and Evolutionnary Biology
Effective Concentrations (ECs) have now largely supplanted NO Observed Effect Concentrations (NOEC), after decades of statistical criticisms towards the latter. ECx has a simple definition which sounds unambiguous. However, depending on the concentration-response pattern, its derivation is not trivial and should be paid attention in the context of ecotoxicological risk assessment. We recently developed a workflow for high-throughput concentration-response modelling of omics data (e.g. transcriptomics, metabolomics). Such data often displayed non-monotonic trends (U or Umbrella shape) as well as linear and exponential trends. After our results, sigmoidal concentration-response shape was more the exception than the rule, as also reported in the literature for such omics data. In this context, we will discuss and explain why these non-sigmoidal trends lead to several issues regarding the derivation of toxicity values. In particular, the derivation of EC does make sense only provided an asymptotic response level is observed at high exposure concentrations and, in the case of non-monotonic trends, requires the definition of a maximal amplitude of the response. Alternatively to EC, the Benchmark Dose (BMD) approach has been proposed in the context of toxicology for setting toxicity values. The BMD approach as mentioned in EFSA guidance proposes two options. The first one considers a x-fold change of the control response which seems hazardously sensitive to the signal level (if the control response is zero, so will be the x-fold change). The second option defines a critical response level accounting for the standard deviation of data (control response + SD). We will illustrate why this feature makes it more robust and usable whatever the concentration-response model.

WE369 Calculating the true ECx/LCx for non-linear models
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Frendt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
Low effect EC values (EC10, EC20) derived from dose-response models have been recommended to replace NOECs in the pesticide regulatory context (e.g., new Regulation (EC) No. 1107/2009) The use of NOEC is often criticized because the standard model power to detect non-effects is low. However, use of the ECx as non-effect values can cause serious over- or under-estimation of ECx/LCx due to the ignorance of control variability, the improper use of binomial assumption behind the probit model, etc. On the other hand, it is nowadays recommended that nonlinear regression models shall be used for dose-response analysis for metric data, which creates another problem in practice because there is inconsistency in the definition of ECx in regulatory context and that in the software implementing these 3 or 4 parameter models procedures. The ECx in programming implementation often assumes the 100% effect is the difference between the baseline response at control and the maximum response at dose level of infinity. EC95 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to control as how it is defined in the current guidelines. This can lead to misinterpretations in the context of regulatory risk assessment. In this study, simulation examples and real data experiments will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

WE370 Review of Dose-Response Analyses in Regulatory Framework
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Frendt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
Low effect EC values (EC10, EC20) derived from dose-response models have been recommended to replace NOECs in the pesticide regulatory context (e.g., new Regulation (EC) No. 1107/2009) The use of NOEC is often criticized because the standard model power to detect non-effects is low. However, use of the ECx as non-effect values can cause serious over- or under-estimation of ECx/LCx due to the ignorance of control variability, the improper use of binomial assumption behind the probit model, etc. On the other hand, it is nowadays recommended that nonlinear regression models shall be used for dose-response analysis for metric data, which creates another problem in practice because there is inconsistency in the definition of ECx in regulatory context and that in the software implementing these 3 or 4 parameter models procedures. The ECx in programming implementation often assumes the 100% effect is the difference between the baseline response at control and the maximum response at dose level of infinity. EC95 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to control as how it is defined in the current guidelines. This can lead to misinterpretations in the context of regulatory risk assessment. In this study, simulation examples and real data experiments will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

WE371
**WE372**

**Aquatic higher-tier exposure testing of pesticides - from complexity to simplicity**

G. Eck, E. Eschenbach, Eurofins Regulatory AG

Field exposure of pesticides is usually characterized by time-variable substance entries into water bodies resulting in complex exposure patterns which often significantly deviate from the constant exposure in standard ecotoxicity tests with aquatic organisms. As an appropriate risk refinement option higher-tier exposure testing is proposed in the current EFSA guidance document for aquatic risk assessments providing the possibility to define ecotoxicologically relevant test conditions partially meaningful link to FOCUS exposimodelling outputs. Studies designed to reflect realistic exposure often result in lower effects. However, FOCUS exposure patterns are frequently challenged in regard to their representativeness for the variety of possible field scenarios and hence are generally not accepted as valid refinement option by several EU Member States. Besides, it is often difficult to generalize various critical patterns of different FOCUS scenarios for an efficient testing and to align these generic patterns with sensitive life stages of the organisms of concern. Practical aspects, types of effects and life traits of test organisms add to the complexity of designing reasonable higher-tier exposure studies. The challenge is to balance representativeness and practicability of test designs. Representativeness can for example be enhanced by multi-year modelling simulations where the variability of treatment and climate constellations are taken into account. Detailed analysis of the multitude of predicted exposure scenarios as well as a detailed analysis of available standard toxicity data is required to develop meaningful test designs and strategies. Generating simplicity from complexity rather than matching exactly the FOCUS modelling exposure pattern is proposed as potential solution to concerns on representativeness as well as practicability for ecotoxicity testing and finally acceptability in a regulatory context. The poster will present examples for the generation of reasonable test designs and strategies that are considered to meet objections towards higher-tier exposure testing as adequate means for refinement of aquatic risk.

**WE373**

**Keeping it real: multidisciplinary approaches to aquatic risk assessment**


Aquatic risk assessments for plant protection products (PPPs) can often be complex, comprising multiple crops, application rates, Member States (MSs) and therefore exposure scenarios. The critical steps of the Tier I assessment (that is, not a realistic representation of the true risk. A number of assumptions and worst-case parameters are used within the Tier I risk assessment, both on the exposure (predicted exposure concentration; PEC) and the effect (predicted no effect concentration; PNEC) side of the equation. To maximise the realism within the risk assessment, it is therefore advantageous to take a multidisciplinary approach, involving specialists in environmental fate, exposure modelling, aquatic ecotoxicology testing and regulatory ecotoxicology when developing refinements for the risk assessment. By developing integrated solutions, it is possible to progress from theoretical to more robust solutions and from worst-case to more realistic estimations of risk. It is proposed here to compare and develop different exposure scenarios using worst-case parameters used in standard exposure models and designing field fate studies to derive more realistic parameters; analysing the exposure profiles associated with the maximum predicted exposure concentration in surface water (PECsw) compared to the exposure conditions used in standard aquatic ecotoxicology studies and designing modified exposure studies to more accurately mimic these exposure profiles, etc. The aim of this poster is to illustrate how different disciplines can work together to challenge the default assumptions of standard aquatic risk assessment, thus enabling appropriate refinement options to be derived and together design optimal solutions that are closer to addressing the real risks, rather than the theoretical ones.

**WE374**

**Critical aspects of higher-tier laboratory exposure testing with different aquatic organisms**

G. Censor, Eurofins Agrosciences Ectox GmbH; U. Memmert, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Hafner, Eurofins Agrosciences Ectox GmbH / Aquatic Ecotoxicology

Reducing exposure testing is an option for higher-tier risk evaluations proposed in the current EFSA guidance document for aquatic risk assessments for plant protection products. It offers scope for risk refinement by defining ecotoxicologically relevant concentrations that might be less conservative than constant exposure scenarios realised in standard effect studies or to justify time-weighted average concentrations in context with chronic risk assessments. Higher-tier exposure testing can be used to transfer more realism into standardised aquatic ecotoxicology testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSA, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under pulsed exposure conditions. The test design allows addressing effects on different sensitive life stages of fish, subsequently and multiply exposed to the test item within the same environment. In the first part, adult spawning fish (i.e. the parental generation, F0) were exposed to 4 pulsed applications at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilisation rate was assessed. The second part was initiated by placing fertilized eggs from the parental groups into the same water sediment systems. This F1 generation was also exposed to 4 pulses of the test item at weekly intervals. Survival and growth of the early life stages were assessed. Other endpoints like endocrine-disruptor effects can be covered by measurement of vitellogenin and histopathological analysis of fish gonads. Glass aquaria of a total volume of 30 L were used and filled with a layer of artificial sediment to ensure stability of the test system throughout the 9-weeks test period. After application, water quality parameters, the pH and salinity were chemically monitored. The evaluation of biological effects was based on mean measured as well as on area under the curve concentrations (AUC) of the test substance in order to be able to compare it to predicted environmental concentrations (PECenv, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT50 values showed that the dissipation profile in the test systems were in line with the predicted exposure profiles in the field. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible distortion of the static system. However, it was demonstrated that the performance of the parental as well as the filament was fine and in line with the quality criteria set by the official test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address both complex exposure regimes and specific endpoint issues.

**WE375**

**Repeated pulsed exposure in a partial life cycle test with zebrafish: Keep it realistic!**

M. Teigeler, Fraunhofer IME / Ecotoxicology; B. Weber, D. Warnecke, RIFCON GmbH Goldbeckstr. Hirschberg Germany

Refrined exposure tests can be used to transfer more realism into standardised aquatic exposure testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSA, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under pulsed exposure conditions. The test design allows addressing effects on different sensitive life stages of fish, subsequently and multiply exposed to the test item within the same environment. In the first part, adult spawning fish (i.e. the parental generation, F0) were exposed to 4 pulsed applications at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilisation rate was assessed. The second part was initiated by placing fertilized eggs from the parental groups into the same water sediment systems. This F1 generation was also exposed to 4 pulses of the test item at weekly intervals. Survival and growth of the early life stages were assessed. Other endpoints like endocrine-disruptor effects can be covered by measurement of vitellogenin and histopathological analysis of fish gonads. Glass aquaria of a total volume of 30 L were used and filled with a layer of artificial sediment to ensure stability of the test system throughout the 9-weeks test period. After application, water quality parameters, the pH and salinity were chemically monitored. The evaluation of biological effects was based on mean measured as well as on area under the curve concentrations (AUC) of the test substance in order to be able to compare it to predicted environmental concentrations (PECenv, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT50 values showed that the dissipation profile in the test systems were in line with the predicted exposure profiles in the field. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible distortion of the static system. However, it was demonstrated that the performance of the parental as well as the filament was fine and in line with the quality criteria set by the official test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address both complex exposure regimes and specific endpoint issues.
M. Teigeler, E. Eilebrecht, Fraunhofer IMM / Ecotoxicology; A.J. Jones, DuPont Crop Protection / Institute of Environmental Toxicology

Refined exposure tests have become part of the regulation framework for plant protection products in the EU (EFSA Aquatic Guidance Document 2013). A pulse dose test can be used to address areas of risk that cannot be satisfied with the standard suite of aquatic toxicity tests. A pulse dose considers situations where the expected exposure event in the field is significantly shorter than in the standard laboratory exposure tests. However, it is yet a challenge to define a common exposure situation from multiple scenarios within one test. Therefore, the maximum exposure (peak) concentration, the number of peaks, the duration of the peaks, and the interval between peaks are considered to simulate a realistic profile covering a large number of scenarios. In this study, three different life stages of rainbow trout (Oncorhynchus mykiss) were exposed to different concentrations of the test chemical. To set these pulses as sharp as possible, the fishes were transferred from treatment vessels to untreated vessels at each time of pulse application. All vessels, including controls, were kept under flow-through conditions. The concentrations of the test chemical were measured at start and end of each pulse event. Fertilised eggs, newly hatched fry and juveniles, already swimming up, were exposed. Glass aquaria with a total volume of 30 L were used. The evaluation of biological effects was based on mean measured concentrations measured for the test substance pulses and could be compared with the predicted environmental concentrations based on FOCUS modeling simulations. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible impairment of the sensitive stages. However, it was demonstrated that the performance of the life stages exposed was acceptable and conforms to quality criteria set by the test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address a very complex exposure regime to cover the ‘worst case’ when a single laboratory exposure is unrealistic.

WE377
TIER2+: Developing the Tools for Future Risk Assessment - New Chronic Invertebrate Test Systems and the Application of Realistic Exposure Scenarios
A. Dabrunz, F. Kümmerl, C. Lang, Eurofins Agroscience Services Ecotox GmbH / Aquatic Ecotoxicology
According to recent and proposed guidance of the European Food Safety Authority (EFSA) current aquatic toxicity test systems should be critically reviewed, adjusted in regards of realistic (e.g. pulsed) exposure and complemented by establishing new test systems. To account for these challenges we will present data on a twofold strategy including A) test systems and B) exposure conditions/\n
Exp. Data of newly established (sub)chronic test systems, which are suitable meeting Tier 2 criteria were used. SSD approach was used for both test systems allowing us to evaluate the effect of the test systems on data quality. For the first test system, we have established a test design for Daphnia magna consisting of exposure concentrations chosen based on mean measured concentrations measured for the test substance pulses and could be compared with the predicted environmental concentrations based on FOCUS modeling simulations. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible impairment of the sensitive stages. However, it was demonstrated that the performance of the life stages exposed was acceptable and conforms to quality criteria set by the test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address a very complex exposure regime to cover the ‘worst case’ when a single laboratory exposure is unrealistic.

WE378
Optimisation of a chronic toxicity flow-through set up to investigate the adverse effects of chemicals to Daphnia magna
C. Beyer, IES Ltd; A. Peither, Innovative Environmental Services IES Ltd; S. Högner, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. C. Abuscher, University of Appl. Sc. Northwestern Switzerland / Institute of Ecopreneurship; P. Corvini, University of Applied Sciences Northwestern Switzerland

Daphnia are playing an important role as representative or indicator species for aquatic invertebrates in the environmental risk assessment for plant protection products, chemicals and pharmaceuticals. To investigate chronic toxicity, semi-static Daphnia magna reproduction tests following Test Guideline OECD 211 have to be performed. So far this test design is also used for highly degrading substances, despite the fact that by using semi-static test design the exposure concentration of the parent test compound is decreasing and metabolic products are accumulating during the renewal intervals of 2-3 days. To ensure a steady exposure level, and to avoid peak concentrations of degradation products, the studies have to be performed in a flow-through system. We are presenting a new flow-through system for reproduction testing with Daphnia magna. The flow-through system may pose additional stress for the daphnids, since interval dosing of test medium is causing turbulence within the test vessels. To preclude that stress effects are given in the new flow-through system, a reproduction test with a hydrodynamically stable test system was carried out. This comparative test allowed studying stress parameters by comparing the effect level concentrations and the EC50 values. Furthermore, a reproduction test with a fast degrading substance was tested to prove the ability of the new flow-through system to maintain a parent compound concentration above 80% throughout the test. In the comparative test both test systems showed the same dose-response-curves and gave the same No Observed Effect Concentration and Lowest Observed Effect Concentration for continuous offspring per survivor after 21 days. Thus it can be assumed that the new flow-through system does not cause additional stress on Daphnia magna in a 21-day reproduction test. In the reproduction test with a non-degrading test item, the new flow-through system could dose the test item concentrations very reliable and precisely (dosed concentrations between 98 and 105% of nominal). In this study, it was proven that the new flow-through system does not cause unacceptable additional stress for the daphnids and can be utilized for reproduction testing with Daphnia magna. All tests conducted in the flow-through system were valid in accordance with OECD Guideline 211. The dosing system is very precise and reliable and is capable to maintain a parent compound concentration above 80% for a test item with half-life of 5 hours.

WE379
Eggs and larval fish test, an alternative method to marine fish exposure: Sensitivity and interest of early life stage.
J. Lancher, C. Dupuy, A. Jourdan, Groupe SGS France; J. Bertin, SGS Multilab / Ecotoxicology
Multi-trophic level bioassays are usually carried out to determine toxicity of effluents, chemicals, cosmetic ingredients, etc... Toxicity to species is different according to the compound type considered, therefore tests on plants, invertebrates and vertebrates should be conducted. On the other hand, vertebrate organism tests should be avoided when possible, including test on juvenile fish. Alternative methods need to be developed for juvenile fish testing, with equivalent predictability and sensitivity. Several alternative methods exist for freshwater studies but there is no standard method available for seawater fish. This study is a first step in the evaluation of a marine fish embryo and larve test as alternative to adult marine fish test OSPAR HOCNF guideline, for example. The embryo and larvae sensitivity of turborep’s C. viridis to daphnids and of the test substance (larvae ablas) to reference substances were evaluated. To this purpose, within 72 hours post-fertilisation, the blastula stage eggs were exposed to reference substances separately. The effects of the toxicants on embryos and larvae were observed daily on a 10-days exposure period. For each reference substance and species, EC50 and mortality rate were calculated. To avoid vertebrate testing, results of this study were compared to published data. Several reference substances had a significant impact on survival of eggs and/embryonic development. The sensitivity of the organisms is significantly different according to reference substances. Moreover, this test was used to evaluate toxicity of waste seawater samples in multi-trophic level bioassays (i.e. combination with single-species on alga, copepod and oyster larvae tests). Based on these results, marine fish embryo test appears as a credible alternative to juvenile fish testing. Therefore additional experiments will be conducted to validate this model.

WE380
Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay
S. Pawlowski, M. Dammann, S. Champ, BASF SE; M. Mathis, FoR, Fort, Environmental Labs, Inc.
The OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100 (amphibian metamorphosis assay - AMA) represents a Tier 1 ecotoxicity test designed to evaluate thyroid disruption. The test exposes Nieuwkoop and Faber (NF) stage 51 Xenopus laevis to different concentrations of the test substance for 21-days and the following endpoints are measured: mortality, hind limb length (HLL), body length (snout to vent -SVL), body weight, developmental stage, asynchronous development, and thyroid histopathology. Of these endpoints, SVL and body weight are measures of growth, whereas developmental stage, asynchronous development, HLL, and thyroid histopathology are in the assessment of thyroid disruption. To co.

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but also standard test organisms for the RA for pharmaceuticals and chemicals.

Diatoms are not only part of the Risk Assessment (RA) for plant protection products, but also of aquatic studies with daphnids or fish. This is important as in daily business in most cases a package of aquatic studies has to be conducted and results shall be comparable.

To overcome such constraints, the aim of the present study was to evaluate the application feasibility of a new technology evaluating *Acartia tonsa* as a biological model to be used in ecotoxicological studies or larviculture. One of the challenges for the Algal Growth Inhibition Test (OECD 2013-2000) is the high number of individuals that are extracted from the soil using high gradient extraction. Until now little is known about vertical movements of benthic communities. Especially in long periods with high temperatures and low precipitation, a high number of soil organisms are extracted from the soil using high gradient extraction. This very flexible and computer controlled dosing device is a modular system which can be easily increased in case that low numbers of individuals are caught. This would then increase the possibility of a robust evaluation of treatments. One activity based trapping method for soil microarthropods would be the soil core traps which were presented at SETAC 2016 by Dehelean et al. 2016. Our poster will discuss possible advantages for the combination of soil core and slide trap sampling and will present first results from the comparison of soil core and slide trap catches.

Regional Agency for Environmental Protection, ARPA Toscana; E. Giacco, University of Genoa; S. Manzo, ENEA / IRSA; F. Savorelli, ARPA Emilia Romagna; L. Pane, University of Genova; G. Sansone, University Federico II Napoli; V. Bellaria, ISPA Institute for Environmental Protection and Research; G. Shriliri, Regional Agency for Environmental Protection, ARPA Toscana

The necessity to develop appropriate methods for the assessment of water quality and effluent toxicity was recognized by environment protection organisations and indicated by legislation, in particular the EU Water Framework Directive (2000/60/EC) and the new Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (EC 1907/2006), both require data from ecotoxicological tests by using algae, crustaceans, and fish. Some tests procedure have already be standardised by organisations (ISO, OECD, USEPA, ASTM), but the freshwater test organisms were indicated more frequently than marine ones. In particular, the lack of specific acute toxicity methods on Mediterranean fish species have involved the adaptation of procedures available for freshwater fish (OECD, 203, 1992). In order to standardize the acute toxicity method for European sea bass (*Dicentrarchus labrax*L., 1758) larvae (species widespread in Mediterranean sea), two intercalibration exercises were conducted by 7 Italian laboratories, according to ISO/IEC 43-2:1997 and ILAC-G13:2000. To this end, for every exercise, the laboratories have conducted 24h test periods with standard test organisms. The intra and inter laboratory variability of the tests were verified and Z-scores values (Z) were computed. Statistical analyses showed no significant differences in the data produced by most of the laboratories. The results indicate the standardization procedure is in advanced stage.

The addi

The necessity to develop appropriate methods for the assessment of water quality and effluent toxicity was recognized by environment protection organisations and indicated by legislation, in particular the EU Water Framework Directive (2000/60/EC) and the new Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (EC 1907/2006), both require data from ecotoxicological tests by using algae, crustaceans, and fish. Some tests procedure have already be standardised by organisations (ISO, OECD, USEPA, ASTM), but the freshwater test organisms were indicated more frequently than marine ones. In particular, the lack of specific acute toxicity methods on Mediterranean fish species have involved the adaptation of procedures available for freshwater fish (OECD, 203, 1992). In order to standardize the acute toxicity method for European sea bass (*Dicentrarchus labrax*L., 1758) larvae (species widespread in Mediterranean sea), two intercalibration exercises were conducted by 7 Italian laboratories, according to ISO/IEC 43-2:1997 and ILAC-G13:2000. To this end, for every exercise, the laboratories have conducted 24h test periods with standard test organisms. The intra and inter laboratory variability of the tests were verified and Z-scores values (Z) were computed. Statistical analyses showed no significant differences in the data produced by most of the laboratories. The results indicate the standardization procedure is in advanced stage.

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P.C. Thomas

Long term ecotoxicity testing of limonene for hazard classification: not such a

exposure conditions and the assessment of persistent effects in spiked, aged test

solution aged for 4h and 72 h which, based on previous research, would be long

remained stable over time and agreed with expected values in comparative

±20% of the initial value) throughout the duration of the test. The actual exposure

poorly soluble species and potential colloidal precipitates in ecotoxicological test

concentrations. We also tried to evaluate the possible contribution of soluble vs.

medium effect concentrations for hazard and risk assessment must consider the temporal

element concentrations to the contaminant of concern must be kept

Agricultural Sciences / Soil and environment; M. Carotenuto, University of Salerno

Department of Chemistry; F.G. Acanfora, University of Salerno / Department of Chemical and Biology; G. Cornelis, Swedish University of Agricultural Sciences / Soil and environment; M. Carotenuto, University of Salerno / Department of Chemistry; B.J. Ferrari, Centre Ecostox EAWEPP; G. Lofrano, University of Salerno / Department of Chemical and Biology

In order to get an appropriate interpretation of ecotoxicological results the exposure

concentrations of test organisms to the contaminant of concern must be kept

constant and stable over the test duration. Increasing evidence suggests that this is

often not the case when dealing with elements that tend to form chemical species

with lower solubility (e.g., oxides and oxoanhydrides for Cd and Sn in the case of some lanthanides). In such situations, the calculation of meaningful
effect concentrations for hazard and risk assessment must consider the temporal

decrease of exposure concentrations to avoid erroneous conclusions. We performed
ecotoxicity tests using semistatic exposure conditions to assess if periodical medium

renewal could compensate for the temporal decrease in element concentrations.

Working in parallel, we conducted a thermodynamic speciation modeling of soluble vs.
colloidal/particulate elemental species to biological effects by testing the

ecotoxicity of solutions aged for different periods. Chromium(III) was chosen as a

model contaminant, but the general approach is applicable to all elements forming

poorly soluble species and potential colloidal precipitates in ecotoxicological test

medium. In medium aliquots amended with Cr(III) (range 0.005 to 1.25 mg/L),

renewal every 24 h was not sufficient to obtain stable exposure concentrations (i.e.

±20% of the initial value) throughout the duration of the test. The actual exposure

range (estimated as time weighted mean concentrations) was between 5 and 275

µg/L and was used to estimate the Cr(III) EC50. On the other hand, concentrations

remained stable over time and agreed with expected values in comparative

experiments performed under static conditions (i.e., without medium renewal).

When comparing the temporal decrease in Cr(III) level during tests, Cr(III) appeared about 10 times more ecotoxic than Cr(VI); in contrast with the current standard. Ecotoxicological effects persisted in solution aged for 4h and 72 h which, based on previous research, would be long enough to remove toxic Cr(III) via hydrolysis (4 h) and to form colloidal Cr-bearing particles (72 h and possibly, and to a lesser extent, 4 h). The use of semistatic exposure conditions and the assessment of persistent effects in spiked, aged test media would allow better hazard assessment for several elements (e.g., lanthanides, Sn, Ga, In) whose concentration may strongly fluctuate in standardized

ecotoxicological media.

WE388

Long term ecotoxicity testing of limonene for hazard classification: not such a lemon after all

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Limonene is a stereoisomeric substance taking its name from lemon, which dominates the composition of the essential oils of citrus fruits. When synthesised as dipentene it is a racemate. However, in botanical sources it is present as the D- or L-enantiomer in Natural Complex Substances (NCSs) obtained at anything from traces in some plant extracts to over ninety percent in orange oil. These oils are considered safe to use as fragrance and flavour. The poster takes a reader through a range of applications (cosmetic products, food manufacture, fragrance perfume, botanical insecticide, household cleaning products, etc.) Therefore, it is predominantly released back to the environment after use. The racemate and both D- and L-limonene received a harmonised classification under Annex VI of the EU C&L legislation as: (Very toxic to aquatic life) and Aquatic chronic category 1: (Very toxic to aquatic life with long-lasting effects). Both classifications have a severe impact on storage, handling and transport requirements of limonene and the many (natural) complex substances and fragrance and flavour mixtures that contain even small amounts of it. The existing classification is a result of a limited data set notably for chronic endpoints. The chronic category 1 classification is extrapolated from the acute category 1 toxicity, log Kow >4 and erroneously assumed not-rapid biodegradability of the substance. As limonene is a narcotic substance its Chronic 1 assignment was expected to be conservative. Due to doubts on the chronic classification and the consequences for labelling, storage, handling and transport, long term aquatic ecotoxicity studies were conducted to obtain a solid basis for the environmental classification. Coincidentally, this expectation was based on statistically significant differences are viewed considered the ecotoxicologists’ Bible for testing difficult substances, the chronic studies were fraught with difficulties. This poster describes the problems encountered by the laboratories when testing a highly volatile, rapidly biodegradable, hydrophobic, non-polar narcotic substance like limonene under chronic conditions, how these were countered by the monitoring team and after a long adventure lasting several years with results supporting a chronic 3 classification. The subsequent regulatory procedure to implement the classification in the EU regulations is currently ongoing.

WE387

Improving ecotoxicity tests for trace elements forming poorly soluble chemical species in test media

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The biogeochemical cycles of several lanthanides (LnS) are being progressively disrupted by their increasing use in industrial sectors such high-tech applications and clean energy generation. Except for a few hotspots located close to the industrial plant, LnS concentrations remain essentially low (i.e., in the µg/L range or lower), but the paucity of available data has fostered research on their possible effects on biological organisms. Getting reliable information on the ecotoxicological potential of LnS is also important in view of the possible (re)opening of mining activities in response to the current monopoly of Ln production by the People’s Republic of China. In this context, testing LnS ecotoxicity following established standard protocols must consider the peculiar chemistry of these elements if meaningful results are to be obtained and used to establish regulatory limits. After addition to ecotoxicological media, typically in the form of soluble chloride salts, LnS can rapidly form complexes with phosphates or carbonates or undergo hydrolysis. Due to the low solubility of LnS-phosphates and LnS-carbonates precipitation may occur forming new LnS-soluble species and potential colloidal precipitates in ecotoxicological test media.

In long-term aquatic ecotoxicity studies, such as mesocosm, a complex statistical analysis is required to decipher the data and determine whether a test-item effect has occurred. It is sometimes the case that regulators and applicants have differing opinions as to what the no observed effect concentration (NOEC) or no observed adverse effect concentration (NOAEC) should be, based on the accompanying data analysis. This expectation was based on statistically significant differences are viewed in isolation from the rest of the available data from the study. The aim of this poster is to urge regulators to not just focus on statistically significant differences, but to take into account all available and relevant data to assess the biological relevance of any differences observed. At CECA we use a range of sampling methods to collect data on aquatic macroinvertebrates within our mesocosm studies, including emergence traps, colonisation of old bricks. Each method is likely to sample different species (e.g., emergent, colonisers and sweep nets) support or contradict a test item effect. In some cases, the same species can be caught using different sampling methods, such as mayflies, damselflies and caddisflies, and this can be from various stages in their life cycle. Comparing the data for the same taxa from different sampling methods can be helpful in creating and overall picture of how that taxa is responding within the mesocosm study. This can be helpful in deciding whether statistically significant differences are biologically relevant; for example, if a statistically significant difference to the control is only observed in one out of three sampling methods used for a particular taxa, this may indicate this is due to natural variation even the influence of the xenobiotic. Here, we will reveal a long-lasting, damselfly and mayfly data from past CEA studies where statistically significant differences have been observed and highlight cases where different sampling methods (emergent, colonisers and sweep nets) support or contradict a test-item effect.

WE390

Evaluation of the environmental risk assessment procedure according to Directive 2001/18/EC for Gene Modified Organisms used as medicinal products

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The deliberate release of genetically modified organisms (GMOs) including GMOs

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used as medicinal products, e.g. gene therapies, into the environment is regulated by directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001. An integral part of the directive regulates the provision of information on the GMO and, based on this, the risk management with regard to the environmental effects of such releases. As regulated by this directive, a publicly accessible database (the "GMO Register") of the JOINT RESEARCH CENTER of the EC (http://gmoinfo.jrc.ec.europa.eu/default.htm) contains information about all GMOs, released for use under a Directive. As of 07.11.2016, there were 238 entries of medicinal GMOs in the "Summary Notification Information Format (SNIF). SNIFs are prepared as a summary document of the confidential environmental risk assessments (ERA) by the respective Sponsors of clinical trials in the EU and evaluated during the clinical trial application by the national competent authorities. Thus, in principle, inter alia, information regarding the GMOs and the parental organism’s nature, release, environmental interactions, monitoring, waste treatment and emergency response plans. We strive to assess information concerning the environmental risk, derived measures and the overall standard of SNIFs concerning compliance with the regulatory requirements. To do so, we picked a homogeneous group of GMOs, namely gene modified Adenovirus, the most frequently used vector in gene therapy trials worldwide. Relevant information were entered into a database and categorized, applying unified vocabulary. Different challenges regarding the information available within the SNIFs were identified by analyzing the database: in several cases mandatory information was not available, e.g. monitoring plans, and in other cases the SNIF documents were misinterpreted, e.g. the connection between replication, dissemination and survivability was interpreted here as the ability to "spill over". The primary basis has been the environmental release of and used by the EU (TC NES) from the early 2000’s enlarging the protection goal to any environment. The criteria became applicable to any chemical produced over 10 TPA when REACH regulation came into force, thus, treating chemicals as a homogeneous group. Interestingly, the criteria were originally defined by using data from a set of chemicals known as highly hazardous for the environment. Such compounds (e.g. chloroorganic compounds) were not-ionic and hydrophobic while the chemical space is much more diverse. In other words, a BCF value of 2000 may be a good cut-off for chemicals which are both highly hydrophobic and slowly metabolised to amplify amplitation along a food chain but may be of limited meaning for other chemical classes. In the US, B is defined as a BCF of >5000 which is the vB criteria in the EU while perhaps the only -5000 which is the vB criteria in the EU while perhaps the only significant correlation with concentrations of toxicants and hence can be used as an up to date versions of the exposure models SimpleTreat and SimpleBox, combined with state-of-art expected mixture pressure calculation using the Van Straalen-Aldenberg convolution integral. The tool estimates the addition of toxic pressure to the ambient toxic pressures in local, regional and continental EU environments, expected from the UVCB mixture. It is proposed that ‘safe use’ is demonstrated sufficiently well by showing that the UVCB under study is expected to contribute negligibly to ambient toxic pressure in the environment. The proposed ‘safe use’ calculation methodology is based on the assumption that is well studied UVCBs. In the poster briefly explains the new UVCB block method and illustrates its potential with the outcomes of test calculations.

WE393 Evaluation of hypohypergall glands development in Honeybees (Apis mellifera L.) from toxicity studies in the light of current guidelines (EFSA and OECD)

Honey Bee (Apis mellifera L.) is a species that belongs to a group called ‘beneficial insects’. All arthropods from this group play the important roles in nature, albeit bees go a few steps forward and they also find application in the food, pharmaceutical and others industries. With the current decline in bee’s colony numbers, these arthropods should be handled with extreme caution. Therefore, it is extremely important to assess the risk for non-target organisms for which plant protection products are often more toxic than pests of agricultural crops. This assessment is related not only to the direct influence of chemicals on the number of bee populations, causing morphological mortality or morbidity, but also indirectly - through the impairment of the ability to raise the larvae, for example by disturbing the work of hypohypergall glands (HPG) responsible for the production of ‘milk’ containing proteinaceous substances to feed larvae and queen. By 2017, the only document regulating the toxicity study of chemicals on bees was the EFSA document (EFSA Journal 2013;11(7):3295), which included continuous access to distilled water and pollen and evaluation of HPG. However, in 2017, the new OECD guideline (no. 245) was introduced, in which the methodology of chronic toxicity testing was changed compared to the EFSA document. Changes occurred in the way of dealing with bees – there is no access to distilled water and pollen, and no evaluation of HPG. It is a significant change, because according to the literature studies, hypohypergall glands do not develop correctly in these bee populations, causing morphological mortality or morbidity, but also indirectly - through the impairment of the ability to raise the larvae, for example by disturbing the work of hypohypergall glands (HPG) responsible for the production of ‘milk’ containing proteinaceous substances to feed larvae and queen. Hence OECD guideline probably does not consider it as an endpoint in the study. As previous study has shown, chemicals can have influence on development of hypohypergall glands, without causing mortality and morbidity. This matter is worthy considering and should be investigated further, in order to introduce the evaluation of hypohypergall glands as an endpoint in toxicity testing of chemicals on bees.

WE394 Assessing toxicity to Daphnia magna using movement parameters
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Daphnia are among the most common settlers of freshwater habitats. These planktonic invertebrates show high sensitivity to various toxicants, therefore representing a useful model organism in ecotoxicological research – with common endpoints being survival, reproductive success and observable morphological changes. Some of recently conducted scientific investigation involving these organisms caused morphological mortality or morbidity, but also indirectly - through the impairment of the ability to raise the larvae, for example by disturbing the work of hypohypergall glands (HPG) responsible for the production of ‘milk’ containing proteinaceous substances to feed larvae and queen. Hence OECD guideline probably does not consider it as an endpoint in the study. As previous study has shown, chemicals can have influence on development of hypohypergall glands, without causing mortality and morbidity. This matter is worthy considering and should be investigated further, in order to introduce the evaluation of hypohypergall glands as an endpoint in toxicity testing of chemicals on bees.

WE395 The validation of analytical methods in ecotoxicology
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The validation of analytical methods (regulated by SANCO/3029/99 rev 4.) used in support of ecotoxicological studies has become an important aspect of the
registration process for plant protection products. When Regulation (EC) No. 1107/2009 came into force, adherence to the SANCO/302999 rev 4. Guidelines became obligatory. This has resulted in serious implications for the registration process because ecotoxicological studies may well now be rejected on the basis of inadequate analytical methodology or incomplete analytical data although the studies have previously been accepted. Here we give an overview of current requirements and provide a checklist that can be used to evaluate analytical methods in ecotoxicological studies.

**WE396**

A new pulsed-exposure early life stage test design for rainbow trout on an insecticide. Refining OECD Guideline 210 to meet the needs of EFSAs Aquatic Guidance 2013

C.S. Ramsden, AgroChemex Environmental Ltd / School of Biomedical and Biological Sciences; C. Gamblin, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco Constant-exposure in OECD TG 210 Fish Early Life Stage studies is unrealistic for fast-dissipating pesticides compared to edge-of-field water-bodies. EFSAs Aquatic Guidance (2013) allows aquatic toxicity studies to be modified so the exposure-profile (peak-height, pulse-duration, number of pulses) is comparable to the worst-case predicted field-exposure. In the present study on a synthetic pyrethroid (SP) insecticide, a novel method was developed to simultaneously assess effects on 3 early life stages of rainbow trout. The TG 210 design was modified to incorporate a worst-case time-variable exposure profile in tanks containing a 10 mm sediment layer and stainless steel mesh barrier to allow water movement but prevent fish disturbing the sediment. Life stages used were newly fertilised ’eggs’, ‘alevins’ (non-feeding larvae) and free-feeding ’swim-up’ fry. To ensure physical separation of the 3 life stages within the tank, eggs and alevins were each held in a glass incubation tube with a mesh base. A control group plus 5 concentrations were used. To start, each group had 4 replicate tanks each with 50 eggs, 20 alevins and 20 swim-up fry. The constant 24 hour static exposure phases on Days 0 and 14. The study duration for organisms starting as ’eggs’, ’alevins’ and ’swim-up’ fry was 72, 45 and 31 days respectively. This allowed for the assessment of effects over a period including at least 2 weeks of growth after initiation of free-feeding for each of the 3 life stages. Standard end points were assessed including hatch success, survival, growth and clinical signs (e.g. loss of equilibrium and coordination). To assess the potential neurotoxic action feeding behaviour was categorised as active, passive and not feeding. This refined-exposure study showed that 3 critical life stages of fish can be tested simultaneously, whilst complying with the fundamental elements of TG 210. Control hatch and survival rates were both > 95%. The design allowed the direct comparison of the sensitivity of each life stage to different concentrations far below than those levels that are expected to cause any toxic effect to aquatic organisms [4]. However, the presence of C60 may modulate the toxicity of some co-contaminants, as described elsewhere [5] Acknowledgment: This work has been supported by the European Communities 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Globauqa and by the Spanish Ministry of Economy and Competitiveness through the project InterCoast (CGL-2014-56530-C4-1-I). It has also received funding from the Generalitat de Catalunya (Consolidated Research Groups “2014 SGR 418” Water and Soil Quality Unit). References: [1] Astefaneei, Alina, et al. Analytica chimica acta 882 (2015): 1-2 [2] Soares, P. et al. Environmental forensics 17 (2016): 47-55. [3] Zakaria, Susanna, et al. Environmental Science and Pollution Research (2017): 1-10. [4] Freixa, Anna, et al. The Science of the total environment 619 (2017): 328. [5] Sanchis, Josep, et al. Environmental science & technology 50.2 (2015): 961-969.

**WE397**

Dissolution of Different Silica Nanoparticles in Aqueous Matrices

M. Macaroni, Adolphe Merkle Institute / BioNanoMaterials; D. Bossert, A. Petri-Fink, B. Rothen-Rutishauser, F. Schwab, Adolphe Merkle Institute / BioNanoMaterials Group Since centuries, silica (SiO2) is used in large scale industrial applications, such as cement manufacture or glass production. In these applications, SiO2 is used in his bulk form. Recently, SiO2 in nanoparticulate form has broadened the range of applications, both in large scale, e.g. as anti-cake agent in food industry, or owing to its abrasive effect in cosmetics; and in small scale, for the production of biosensors, swim-up fry. There were two 22 hour statics [1]. The use of silica nanoparticles (SiO2-NPs) as a delivery vehicle for molecules in plants is being investigated [2], demonstrating their potential in environmental applications. Many of the current uses increase the likelihood that SiO2-NPs could accumulate in the environment and in food webs. Therefore, it is crucial to investigate the dissolution of SiO2-NPs in different environments. Besides information about the degradability of the nanomaterials, this knowledge will also allow to produce more environmentally friendly products. Here, we present the results of a method development to quantify the dissolution of different SiO2-NPs in aqueous media in order to determine the dissolution kinetics. This method relies on the use of indirectly coupled plasma optical emission spectroscopy (ICP-OES) for the quantification and the parallel characterization of the particles by transmission electron microscopy (TEM) and dynamic light scattering (DLS). A simple setup based on dialysis membranes, and a sampling protocol are in the process of being established. The first results indicate that is possible to detect the dissolved fraction of SiO2-NPs roughly 60 nm in diameter within about one day. Long-term dissolution experiments will be performed in the coming months to determine the dissolution kinetics more precisely. This setup will serve as a tool to assess the behavior of SiO2-NPs in environmental media. [1] Barik TK, Sahi B, Swain V. 2008. Nanosilica—from medicine to pest control. Parasitology Research. 103:253, [2] Torney F, Trewyn BG, Lin VSY, Wang K. 2007. Mesoporous silica nanoparticles deliver DNA and chemicals into plants. Nature Nanotechnology. 2:295. Acknowledgement - The authors thank the Swiss National Science Foundation (project 168187) and the Adolphe Merkle Foundation for the support and funding of the study, and Laura Rodriguez-Lorenzo for her precious advice and suggestions.

**WE398**

Occurrence of fullerene aggregates in Mediterranean rivers: Two cases of study

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Fullerenes are carbon nanomaterials that have many potential applications in nanotechnology and that can be generated in some combustion processes. Since their environmental effects and behaviour are uncertain, fullerenes are considered emerging contaminants and during the last years they have been included in some eco-toxicological studies. However, few studies have reported the presence of fullerenes in water systems. In order to assess the environmental risk of fullerenes it is important to enlarge the dataset and to characterize the concentrations of these nanomaterials in different rivers. In the present work, C60 fullerenes, C70 fullerenes and five functionalized derivatives were determined in water and sediment samples from two Mediterranean rivers. The first case of study was located in the Sava River (Souttheastern Europe), where more than 30 samples were studied in two sampling campaigns. In the second case of study, samples of estuary water, wastewater, river water and coastal water from the Ebro River delta were analysed. In both studies, C60 was the most ubiquitous compound and it was detected for the first time in the marine environment, although its concentrations were below the ng/l order in all the cases. The toxic fullerene (C60) was also detected in environmental sample from the Sava River. The results show that fullerenes are present in the aquatic environment although at concentrations far below those that are expected to cause any toxic effect to aquatic organisms [4]. However, the presence of C60 may modulate the toxicity of some co-contaminants, as described elsewhere [5] Acknowledgment: This work has been supported by the European Communities 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Globauqa and by the Spanish Ministry of Economy and Competitiveness through the project InterCoast (CGL-2014-56530-C4-1-I). It has also received funding from the Generalitat de Catalunya (Consolidated Research Groups “2014 SGR 418” Water and Soil Quality Unit). References: [1] Astefaneei, Alina, et al. Analytica chimica acta 882 (2015): 1-2 [2] Soares, P. et al. Environmental forensics 17 (2016): 47-55. [3] Zakaria, Susanna, et al. Environmental Science and Pollution Research (2017): 1-10. [4] Freixa, Anna, et al. The Science of the total environment 619 (2017): 328. [5] Sanchis, Josep, et al. Environmental science & technology 50.2 (2015): 961-969.

**WE399**

Occurrence, fate and behaviour of fullerenes in the environment

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The occurrence, fate and behaviour of carbon nanomaterials in the aquatic environment are dominated by their functionalization, association with organic material and aggregation behaviour. In particular, the degradation of fullerene aggregates in the aquatic environment is a primary influence on their mobility, sorption potential and toxicity. In this presentation, a summary of the occurrence of fullerenes in environmental matrices performed in different studies of our group will be presented. The analytical approach to investigate seven fullerenes (C60, C70, N-methylfulleropyrrolidine, [6,6]-phenyl C60 butyric acid methyl ester, [6,6]-thienyl C60 butyric acid methyl ester, C60 pyrrolidine tris-acyl ethyl ester and [6,6]-phenyl C60 butyric acid methyl ester) in waters, soils and sediments combines an extract-assisted solid-phase extraction (SPME) and an electron impact followed by liquid chromatography (LC), using a pyrenyl[propyl] group bonded silica based column, coupled to a high-resolution mass spectrometer (HRMS) using atmospheric pressure photo ionisation (APPI) in negative ion mode. Main results of these studies showed levels of pg/mg·ng/m² in atmospheric aerosols, pg/g·ng/g in soils and pg/l·ng/l in river waters. The composition of different fullerenes including pristine fullerenes (C60 and C70) and functionalized ones from the engineered origin will be discussed. In addition, different degradation studies of fullerenes in water suspensions emulating different environmental conditions and during a wastewater treatment will be presented. Degradation studies have been carried out under controlled conditions of salinity, the humic substances content, the pH and the sunlight irradiation. The results of degradation studies will show that up to ten transformation products are produced, including epoxides and dimers. Finally, the kinetics of generation of each transformation product will be as well presented.
The influence of engineered surface coatings on nanomaterial stability in a complex, natural medium

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The colloidal stability of engineered nanomaterials (ENMs) within aquatic environments is largely a function of the surface coatings as acknowledged by a number of recent studies. The research using simplified, synthetic mediums has demonstrated that ENM stability is strongly influenced by the engineered surface coating enveloping the ENM. However, it is unknown whether this coating will continue to dictate particle stability when the ENM is dispersed within a complex, natural medium. Instead, it has been suggested that the “eco-corona” acquired by the ENM via interactions with the surrounding environment will govern ENM stability. This implies that within these mediums, engineered surface coatings will have a negligible impact upon ENM stability. The aim of this research was to investigate this subject further and determine whether an ENMs’ engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium. Using samples of a local freshwater river to represent a complex, natural medium, a suite of batch experiments were conducted. Each batch was dosed with a single model ENM, which included 12–15 nm gold-core nanoparticles (AuNPs) with different surface coatings (e.g., diverse surface charges, stabilization mechanisms). Aliquots were collected from each batch over time, immediately centrifuged to remove large particles/aggregates, and the supernatant collected for analysis via ICP-OES. From this, the concentration of unaggregated AuNPs remaining in the supernatant over time was tracked, as well as the percentage of AuNPs remaining. As an indicator of ENM stability, the supernatant concentration at each time point was calculated. As an indicator of ENM stability, the supernatant concentration at each time point was calculated. More importantly, however, was that both the neutral and negatively-charged ENMs remained stable throughout the duration of the experiment (8 hrs.). This suggests that the surrounding environment did not affect the stability of these ENMs and demonstrates that ENM stability is influenced by the engineered surface coating, even after interacting with a complex, natural medium.

WE401 Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

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The rapid evolution of nanotechnology poses a unique and significant challenge for wastewater treatment plants (WWTPs). Engineered Nanoparticles (ENPs) are already utilized in a diverse array of applications, including cosmetics, optics, medical technology, textiles and catalysts. As the market grows, we will see increasing input of ENPs into WWTPs. Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

WE402 Fate factor of engineered TiO2 nanoparticles in aquatic and terrestrial natural environments

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Engineered TiO2 nanoparticles are used in several fields such as construction, cosmetic and food which leads to an important production and inevitably to emissions generating environmental impacts. To quantify them, the Life Cycle Assessment is a powerful tool that is able to characterize TiO2 NPs according to their fate in environmental media and their effects on ecosystems and human health. The main objective of this study is to determine the engineered TiO2 nanoparticles (TiO2 ENPs) fate according to two approaches: experimental and by calculation. For this purpose, it requires firstly to detect and quantify TiO2 NPs not only in water, soil and sediment near a production site in Vieux-Thann (68) to determine parameters which control the fate of TiO2 NPs and secondly to develop methods which are used in particular inductively coupled plasma with atomic emission spectrometry (ICP-AES), transmission electron microscopy (TEM) and conductivity or potential of hydrogen (pH) measurements. Then, parameters determined in the previous steps are used to calculate a fate factor of TiO2 ENPs in a natural environment according to the life cycle impact assessment method (LCI-En). During the study, it was found that ionic strength, pH, percentage of organic matter, soil composition (percentage of clay, silt and sand) or size and concentration of TiO2 NPs are parameters which matter in TiO2 ENPs fate in soils, water and sediments. Furthermore, the first results obtained show that the sampling point located upstream of the production site has the lowest concentrations of titanium dioxide in soil and sediments. This point is used as a reference and allows to determine the degree of decrease in concentration changes and flux of TiO2 NPs in soil and sediment.

WE403 Assessing the fate and transport of engineered TiO2 nanoparticles in sewer pipes through a dynamic multimedia model (SWNano)

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Assessing the fate and transport of engineered TiO2 nanoparticles in sewer pipes through a dynamic multimedia model (SWNano)

During the past decades, the nanotechnology and use of engineered nanoparticles (ENPs) have rapidly developed. It is therefore inevitable that they enter the natural environment such as rivers and marine environments. So various models have developed to expect exposure amounts in environment for proper risk assessment of ENPs. However, there is a lack of filed observation data due to deficiency of monitoring techniques for ENPs. Therefore, we estimated attachment efficiency through sedimentation experiment of TiO2 NPs in real wastewater and we compared sedimentation rate with the values experimented in laboratory tests. From this, we developed an analytical model including H2SO4–HNO3, microwave assisted digestion coupled with ICP-OES to measure ENP concentrations. Based on this, using laboratory microcosms we assessed the kinetics of ENP removal by activated sludge. The kinetic design we adopted provided different ENPs' sedimentation rate, even after interacting with a complex, natural medium.
Nanoparticles (NPs) can behave as particle agglomerates that participate in sorption/desorption processes, in the context of photodegradation and photoactivation. Some PAHs are photoactive and have enhanced environmental behavior. Polycyclic aromatic hydrocarbons (PAHs) are a class of persistent environmental contaminants with diverse physicochemistry and toxicities. In contaminated aquatic environments, PAHs frequently accumulate in sediments or are sorbed to particulates in the aqueous phase. Some PAHs are phototoxic and have photo-induced toxicity, but little is known about interactions between PAHs and NPs. The presence of NPs can alter PAH metabolism and toxicity under UV-A radiation. In these experiments, bioavailability (cytochrome P450A1 cytochrome A gene expression in larval zebrafish) is used as an analytical tool to demonstrate sorption of antracene and benzo(a)pyrene to NPs in water. Our objective is to investigate PAH/TiO2-NP sorption under UV-A and solar spectra. The presence of NPs can alter PAHs’ bioavailability and toxicity. Various combinations of PAH/TiO2-NP preparations will be exposed to UV-A, and changes in gene expression of genes involved in Phase I metabolism (cytochrome P450 cytochrome A and cytochrome B) and Phase II metabolism (gst, epox, gsh; and epoxide hydrolases epb/1 and epb/2) in early life stages of zebrafish will be assessed. The exploitation of biological responses in PAH and PAH-NP combinations is an essential part of an environmental risk assessment. Product bioavailability during sorption processes will provide novel insights into these processes tested directly within the environmentally relevant aqueous phase.

WE407
Toxicity of TiO2 nanoparticles to freshwater chironomids - pointing out the relevant endpoints
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In the environment, nanomaterials are present in a number of chemical forms, exhibiting specific interactions, mobility, biological availability and potential toxicity. Both ecotoxicologists and pathologists have expressed their concerns regarding the potential negative effects of nanomaterials in live systems and the environment. The present study was carried out in order to assess the influence of TiO2 nanoparticles (in the form of human white food colorant E171) toxicity on the freshwater midge Chironomus tentans. The safety and consequences of the intake of this form of E171 TiO2 for human health have been recently reconsidered. The experimental design was constructed for the sediment dwelling chironomid larval according to OECD guidelines. Concentrations of 125, 250, 500, 1000, 2000 and 4000 mg/kg E171 TiO2 per kg of sediment were tested. The effects of E171 TiO2 toxicity were assessed in terms of sublethal effects (mortality, emergence ratio, developmental time and rate). Concentrations of 2.5, 25 and 250 mg of E171 TiO2 per kg of sediment were used to assess sublethal effects (mortality and survival), effects on feeding and reproduction. The first time a geometrical morphometric approach was used to assess the deformities in chironomid larvae exposed to nanoparticles. Geometric Morphometrics revealed the tendency of the mentum teeth to narrow and elongate and the mandibles to widen by the first inner tooth, with a rise in the TiO2 concentration. The present study revealed the most suitable endpoints in the case of TiO2 nanoparticle contamination in freshwaters, using Chironomus tentans as a bioindicator. The results show that morphological change of C. tentans could be used as an endpoint in nano-TiO2 monitoring together with geometric morphometry.

WE408
Multigenerational exposure of the nematode C. elegans to Silver Nanoparticles at the expense of oxidative stress defence mechanisms
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Adverse effects of Ag are widely known, with effects ranging from oxidative stress, DNA damage and gene expression inhibition to decreased life span, daylength, body size, growth and reproduction. Most toxicological studies, however, only cover a limited timescale of the organism’s life stage, rather than the whole lifespan, or even across generation. Therefore, knowledge on multigenerational effects is lacking. The current study was conducted in order to determine whether the six generational exposure to sub-lethal concentrations of either ionic or nanoparticulate silver (AgNP) could induce alterations in sensitivity to Ag exposure using the nematode C. elegans as a model. Further, changes in susceptibility to other metals and the role of ROS as well as metabolic changes were investigated. Exposure to sub-lethal concentrations revealed increased susceptibility to ionic Ag, while...
AgNPs tolerance increased. Results show that adaptation development may occur after just a few generations. Subsequent exposure to paraquat, a known ROS inducer, indicated the involvement of ROS defense mechanisms. Therefore, changes in glutathione redox potential and sod-1 gene expression were measured, employing the genetically encoded fluorescent biosensors Gpxt-roGFP2, and the reporter strain Sod-1::gfp, respectively. Further, effects of the AgNPs on the central metabolism and implications on energy production are investigated by monitoring the root surface of A. thaliana exposed to AgNPs in comparison with PE255.

Findings of this study will aid to further improve the understanding of the toxicity of nanoparticles, as well as contribute to our knowledge about the behavior of C. elegans in response to toxicants. Acknowledgements: Karl Andreas Jensen and Solfrid Lohne. This work was supported by the Norwegian Research Council funded NanoCharm (22139/EB40) and NorNanoReg (239199) projects, and the EU NANOREG project grant agreement n° 310584.

WE409 Effect of silver nanoparticles layer on soil surface to terrestrial species J. Kwak, S. Nam, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

With developing nanotechnology, uses and release of engineered nanomaterials are increasing. Landfill of biosolid after wastewater treatment is considered as one of indirect emission sources of nanomaterials. This study focused on the simulation of exposure scenarios of nanomaterials landfills, and set the aim to investigate different toxic effects derived from different scenarios. Silver nanoparticles (AgNPs) was selected as a test nanomaterial due to its diverse properties. The effects were considered: 1) control, 2) layer of AgNPs with low concentration (Low-Layer), 3) layer of AgNPs with high concentration (High-Layer), and 4) mixture of AgNPs and soil with low concentration (Low-Mix). Plant microcosm experiment was conducted in the greenhouse for 9 weeks. Soybean plant was most inhibited in Low-Mix exposure group which mimicked whole mixture of nanomaterials and soil because the root surface area was much larger than AgNPs particles in Low-Layer and High-Layer. In case of soil enzymes, activities were depended on exposure concentration. This study concluded that exposure concentration of nanomaterials as well as depth of nanomaterials layer should be considered in the soil ecotoxicity research area. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and future planning (2016R1A2B3010445).

WE410 Fragmentation of nano- and microplastics from expanded polystyrene exposed to sunlight Y. Song, Korea Institute of Ocean Science and Technology; W. Shin, S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group; S. Eo, Korea Institute of Ocean Science and Technology

Production of nano- and micro-sized plastics through weathering of plastic surface by photo-oxidation was regarded as one of major input sources of secondary nano- and microplastics. Its fragmentation process according to exposure duration and sunlight intensity were not well investigated. Therefore, it was not revealed yet. Expanded polystyrene (EPS), one of common marine plastic debrises, was known to weather more rapidly than polyethylene and polypropylene in our previous study. Fragmentation of nano- and micro-sized particles was qualitatively and quantitatively determined from the expanded polystyrene (EPS) exposed to sunlight for 9 months. The exposed EPS cubes (3x3 cm surface area) were sampled in duplicate at 2 (2M), 5 (5M) and 9 month (9M) after sunlight exposure. The collected particles in solution were fragmented particles at the surface of each cube directly exposed to sunlight were collected in 2 ml solution consisting of HPLC grade pure water with 0.1% tween 80 by sonication for 1 min. The collected particles in solution were sequentially filtered with 10 µm and 0.8 µm pore-size filter paper. The mass of > 10 µm EPS particles produced per EPS cube surface area (g/m²) significantly (p<0.05) increased according to exposure time: 0.1±0.1 g/m² for control, 2.6±0.3 g/m² for 2M, 3.9±0.4 g/m² for 5M and 7±0.2 g/m² for 9M. The mean and median size of > 10 µm EPS particles measured by laser diffraction was 26-29 µm and 18-20 µm, respectively. The hydrodynamic diameter of the EPS particles in the filtrates of < 0.8 µm pore filter paper was 32 nm for 2M, 530 nm for 5M and 732 nm for 9M by dynamic light scattering. Their particle abundances measured by nanoparticle tracking analysis were 1.8±10^11 particles/ml for 2M and 3.2±10^11 particles/ml for 2M and 9M. Two month exposure of EPS to sunlight was enough to produce a large number of micro- as well as nano-sized plastics by surface weathering.

WE411 Effects of nano-plastics on natural marine aggregates and their associated microbial communities S. Summers, SCELSCE Nanang Technology University / SCELSCE; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society; T. Gutierrez, Heriot Watt University / School of Life Sciences

Plastic debris in the marine environment is of particular interest, as the issue is one on a truly global scale. The ubiquitous presence of micron sized plastic particles and the knowledge that these will break down into ever smaller, nanometre sized particles, has resulted in a surge of recent research into nano-plastics. However, the difficulty in detection of nano-plastics has made it difficult to predict the specific risks involved in their presence within a marine environment. We recently showed that nano-plastics are readily incorporated into marine snow (MS) particles as mediated by ‘sticky’ polymeric substances and other particulates. MS particles are described as a heterogeneous matrix composed of polymeric substances, such as EPS, faecal pellets, invertebrate casts and microorganisms. It is therefore expected that the distribution of nano-plastics with MS would include plastics to the total pool of suspended particulate matter. Studies undertaken in the case of this pool of MS-associated nano-plastics, however, are lacking, including the microorganisms found colonizing these particles. Since microorganisms, in particular bacteria, are major colonizers of MS, we hypothesized this would also be the case for MS-associated nano-plastic particles. To assess this, we generated MS-associated nano-plastic particles from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres. Analysis of the nano-MS-plastics parceled by barcoded 16S rRNA gene MiSeq sequencing revealed that the addition of nano-plastics introduced some minor variability within treatments, with respect to microbial composition. The presence of the nano-plastics marginally increased the a-diversity of the community associated with the particles, compared to the community associated with MS in the absence of nano-plastics. Statistical analysis, however, did not provide substantive evidence to suggest that these differences and variabilities were significant. Therefore, while nano-plastics may have some minor effect in terms of the diversity of bacteria that colonize MS, it was less than the natural variability observed for the microbial communities that colonized non-exposed (no nano-plastics) MS particles. This study results suggest that nano-plastics may exert a major influence in altering the bacterial communities associated with MS particles.

WE412 Tracking nano-plastics in marine bivalves at environmentally realistic concentrations M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; J.S. Rowland, University of Plymouth / School of Geography Earth and Environmental; K. Stevenson, Charles River; C. Roleau, Pesches et Oceans Canada; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society; R.C. Thompson, Plymouth University / School of Marine Science and Engineering

Awareness campaigns on plastic pollution in oceans are backed by governments worldwide with recent initiatives to ban plastic products such as micro-beads from cosmetics or single-use plastic bags. The fragmentation, the persistence and the production of plastic particles (micro < 1mm, MPs, to nano-size < 1µm, NPs) are among the most prominent environmental issues faced by government environmental agencies. However, most, if not all, of our current understanding about this waste pollutant such as plastic particles is their tissue distribution if ingested by an organism. Therefore, the success of environmental plastic monitoring programs will ultimately depend on the reliability of extraction and detection of plastic particles in tissues of diverse organisms. However, most exposure experiments performed with plastic particles are carried out with unlikely high doses of particles, typically above 1 mg/ml while the environmental concentration is expected to be a part of a pollutant at realistic concentrations. Therefore, the major tracking and detection of such small particles at these low concentrations are indeed major analytical challenges for environmental and laboratory studies. Our study focuses on the tissue distributions of nanoplastic in marine bivalve in a single pulse exposure of 6 hours and depuration of 48 days in open clean seawater. Here we present, preliminary results where we track nanoplastics at environmentally realistic concentrations in marine bivalves.


Plastic pollution is a widespread concern worldwide. Substantial amounts of plastics are produced and discharged into the environment every year, which will potentially impact aquatic ecosystems and consequently aquatic organisms. Plastic in the aquatic environment can undergo mechanical, chemical and biological degradation that can give rise to the formation of particulates, which can be denominated as micro- (< 1 mm) or nano-plastics (< 100 nm) depending on size range. Microplastics are ingested by a range of aquatic organisms and this ingestion might cause adverse biological effects, however less research has been conducted on their smaller counterparts, nanoplastics (NPLs). Similarly to other nanomaterials, NPLs possess size specific properties which could increase their toxic potential towards aquatic organisms depending on surface characteristics and interactions with the surrounding environment. Nonetheless, their presence in the environment and any toxic mechanisms are, to a large extent, unknown. In this study, the impact of environmentally relevant plastics identified in Norwegian
environmental samples will be evaluated at the nanoscale in three key marine species, the cryptophyte algae Rhodomonas sp, the harpacticoid copepod Tisbe battagliali and the blue mussel Mytilus edulis and compared to its microscale counterpart. The uptake, accumulation and elimination kinetics of NPLs in the three species will be evaluated under ecologically relevant conditions, as well as their potential transfer along the aquatic food chain. Furthermore, the acute and sublethal ecotoxicological effects of both plastic sizes will be investigated at individual, cellular and molecular levels using different biological endpoints. With the results obtained in this study we aim to discuss the differences in uptake, accumulation and biological responses between different sized plastics identified in the Nordic environment, and consequently bridge the current knowledge gap on the assessment of their potential hazardous effects in marine biota.

WE414 Ecotoxicity of engineered nanomaterials in relation to ecosystem complexity and functioning

W. Peijnenburg, RIVM / Center for Safety of Substances and Products; Y. Zhai, CML Leiden University; M.G. Vijver, CML Leiden University / Conservation Biology

Engineered nanomaterials (ENMs) are widely applied, and the release and accumulation of ENMs through waste effluent and deposition are threatening the aquatic and terrestrial ecosystem. While important knowledge has been gained about the uptake of ENMs on cultured invertebrate and microbial species based on simplified microcosm and mesocosm model systems, extrapolation of results of these short-term tests to natural ecosystems is challenging. This presentation will explore the potential of ENMs to affect the aquatic and terrestrial environment, and will discuss the importance ofENMs on single species but also a need of a comprehensive framework of nano-specific toxicity in complex ecosystems. Considering the abiotic complexity of the transport of ENMs in the natural environment, studies performed with laboratory-cultured species need to include proper characterization and quantification of the environmental factors that impact fate and effects of ENMs. In addition, the biotic complexity in the ecosystem especially in the aquatic and terrestrial environment indicates that risk assessment of ENMs should be conducted in an integrated multi-dimensional perspective. For instance, relatively simple studies on uptake and accumulation of ENMs by invertebrate species need to further investigate the perturbation caused by interactions between the intestinal and the plethora of environmental variables that affect the fate and toxicity of ENMs over various spatial and temporal scales. In this context, an overview is given on recent achievements in assessing nano-specific effects on systems varying in physico-chemical and biological complexity. Amongst others, it will be illustrated how ENM toxicity can be affected by the intrinsic physico-chemical characteristics of ENMs (e.g. shape, size, surface charge, coating) and extrinsic environmental characteristics (NOM, pH, electrolytes) and how ENMs interact with various components of food webs. ENMs in the environment may directly or indirectly affect a diverse array of organisms and microorganisms, which likely cascades towards distorted ecosystem processes. We further identify challenging yet promising research areas in this emerging field that are essential in pursuing a realistic risk assessment that accounts for ecosystem complexity and functioning. The take home message is that there is a need of studies assessing not only impacts of ENMs on single species but also a need of a comprehensive framework of nano-specific toxicity in complex ecosystems. Considering the abiotic complexity of the transport of ENMs in the natural environment, studies performed with laboratory-cultured species need to include proper characterization and quantification of the environmental factors that impact fate and effects of ENMs. In addition, the biotic complexity in the ecosystem especially in the aquatic and terrestrial environment indicates that risk assessment of ENMs should be conducted in an integrated multi-dimensional perspective. For instance, relatively simple studies on uptake and accumulation of ENMs by invertebrate species need to further investigate the perturbation caused by interactions between the intestinal and the host. Also, the link between microorganisms and invertebrates in a detrital food web should be included for a systematically evaluation of ENMs toxicity.

WE415 Development of rapid reacting automatic mobile lab responding chemical accident of aquatic environment in Korea

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Most of available mobile lab developed and operated in Korea are air quality monitoring system and there is no rapid reacting mobile lab responding chemical accident of aquatic environment in Korea. We designed rapid reacting mobile lab with two major factors, 24hr operating and rapid starting within 1hr after arrival. We also considered system stability during transportation and accessibility to target river or stream, where we collected vibration information of a vehicle by exposure to vibration and raised spot of a road and reduce speed. Vibration information analysis was conducted with vibration testing shaker. We also collected topographical information related to diversified accessibility characteristic to river by conducting sampling at the selecting sampling point. Lastly, we adopted special air-conditioning system to control the system contamination from exposure to vaporized chemicals at the accident location. We adopted dual power supplying system with 5.5kWh capacity 24hr operation efficiency with 2hr supplementary battery system of 10kWh assisting and initiating the system on arrival and in between generator exchange. Vibration testing shakers are established with vibration information collected. Activated carbon proved to be most effective to control our target chemicals, which was composited onto COMBI type filter. These findings will be modulated and structured to maximize system stability.

[Keywords] chemical accident, mobile lab, rapid monitoring system

WE416 Trophic Interactions in the Bioaccumulation and Depuration of Silver in Fish from a Lake Dosed with Nanosilver

C.D. Metcalfe, Trent University / Water Quality Centre; V.V. Yargeau, McGill University / Chemical Enenneering; K. Newman, J.D. Martin, Trent University / Water Quality Centre

Bench-scale tests have shown that silver (Ag) accumulates in the tissues of fish exposed to silver nanoparticles (AgNPs). However, these experiments cannot replicate the complex biogeochemical processes and trophic interactions in natural aquatic ecosystems. This study was conducted as part of whole lake addition project in which a total of 15 kg of AgNPs was added over two ice-free field seasons to a small lake (i.e. Lake 222) in the Experimental Lakes Area in Canada. Both yellow perch (Perca flavescens) and northern pike (Esocus lucius) accumulated Ag in their tissues. The greatest bioaccumulation was observed in the liver tissues of pike, and a smaller amount was observed in muscle tissue. No bioaccumulation observed in liver of 5.1 μg/g wet weight. In pike, the highest concentrations of Ag were observed in gill tissue. Monitoring in the lake using passive sampling devices and single particle ICP-MS confirmed that Ag nanoparticles were present in the water column and that Ag was distributed throughout the lake at estimated concentrations in the range of 1-11 μg/L. These data indicate that the primary mode of Ag bioaccumulation in perch was probably through uptake into the gill, whereas pike probably accumulated Ag from the diet. The transfer of Ag from forage fish to piscivorous fish can occur in natural lake ecosystems, leading to concentrations in some tissues that are 3 orders of magnitude greater than the concentrations in water.

WE417 Hepatotoxicity of iron oxide (magnetite) nanoparticles in the guppy Poecilia reticulata

G. Qualhato, Federal University of Goias / Department of Morphology; T.L. Rocha, University of Algarve / CIMA; S.M. Saboia-Morais, Federal University of Goias / Department of Morphology

Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomaterials field, its ecotoxic effects to aquatic organisms remains unclear. In this study, the hepatotoxic effects induced by citrate-functionalized IONPs at environmentally relevant iron concentration (0.3 mg L⁻¹) was investigated in female guppy Poecilia reticulata by histopathological approach based on qualitative analysis and histopathological index after acute and long-term exposure. The animals were collected at the beginning of the experiment and after 3, 7, 14 and 21 days of exposure. TEM results demonstrate crystalline and rounded IONP with an average size of 3.97 ± 0.85 nm, and DLS and ELS analysis showed that the IONPs have low hydrodynamic diameter and high surface charge in ultrapure water (14.11 ± 0.2 nm; ±7.1 ± 7 mV) compared to reconstituted water (21.4 ± 0.39 nm; -19.5 ± 6.5 mV). The histopathological results showed an increase in the frequency of histopathological changes in fish after the 7 days of exposure to IONPs, such micro- and macro-steatosis, melanomacrophage aggregates, exudate and hemorrhagic foci. The acute (3 and 7 days) and long-term (14 and 21 days) exposure of P. reticulata to IONPs induced high histopathological indexes associated with circulatory disorders and inflammatory responses with high foci of melanomacrophages indicating an increase of hepatotoxicity according the exposure time. Furthermore, guppies exposed to IONPs showed increasing in the number of MMC when compared to the unexposed ones. This is a first study about hepatotoxicity of IONPs in guppies. The results indicated that the hepatotoxicity estimated by qualitative parameters and histopathological index are important biomarkers to indicate the animal health and the environmental impact of IONPs. The present study confirming that the guppy P. reticulata is a suitable model to test the hepatotoxicity of IONPs. Keywords: Nanomaterials; biomarkers; eco; nanotoxicology; guppy; Session: Ecotoxicology and human toxicology: from molecules to organisms, from omics to in vivo (Fish model species in human and environmental toxicology) Presentation preference: Poster presentation

(Eco)toxicity tests for hazard evaluation of recycling materials and waste (P)

WE418 Bioteists for Hazardous Waste Classification (HP14): benchmarking Limits for Tolerable Ecotoxicity

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The current HP14 classification is based on the biological composition of the waste: i.e. the sum of the concentrations of individual chemicals with ecotoxic properties (substances labeled H400, H410, H411, H420) are compared to defined limit values (CLP). In the case of complex waste materials however the analytical data are not sufficient for the EC classification. A toxicological approach using bioteists for the chemical evaluation as step 1 bioteists in steps 2 (acute aquatic tests on eluate fractions) and step 3 (acute terrestrial tests on solid waste). Limit values are needed for tolerable ecotoxicity (TE) that are in line with the chemical limit values (step 1). In the study presented here we benchmarked bioteist results against waste materials that were proven to be toxic in step 1, and it was conclusion that LID4 as TE was a suitable option for our data set. The main conclusions were: The proposed set of bioteists is essential for proper HP14 evaluation. Poor mass balance in the chemical data should be the trigger for the additional use of bioteists. LID 4 is proposed as TE
for steps 2 and 3 (to be further evaluated for a larger data set). Both aquatic and terrestrial tests are needed for complete HP14 evaluation. This study was funded by OVAM, the Flemish Waste Agency! The kind help of the technicians Guy Geukens, Cis Boonen, Wilfried Dumortier is highly appreciated.

WE419 What is the future for the waste wood in terms of ecotoxicological testing? S. Legay, FCBA / Chimistry Ecotoxicology Lab, C. Martin, FCBA / Gironde In Europe, the classification of waste is carried out by an assessment of the hazardousness of the waste using data of known waste composition according to the properties of danger. This classification can be based only on the waste composition if the available data are sufficient and relevant. This method is based on the sum of concentrations of waste classes with CEN/TS 16637 (Classification, Labelling, Packaging) regulation [European regulation [EC] 1272/2008]. In the majority of cases under complex mixtures, of or unknown nature (e.g: exterior and interior joinery, furniture, panels, wooden paneling, wood flooring, construction waste and demolition,..) including wood preservative, paints, glues, the characterisation of their wastes is considered to be difficult. Eco-toxicological testing seems to be the most relevant because the effects of all contaminants (synergistic effects, additives and antagonists) are integrated. It is a major advantage in the characterisation of waste. In this case, the waste has to be then subjected to a battery of bio tests (aquatic and terrestrial) in order to evaluate one of the 15 existing properties: Eco-toxicity for the environment (HPI4). Test strategies will allow wood wastes to be recovered or recycled.

WE420 QUALITY STANDARDS FOR URBAN WASTE FERTILIZERS: PUTTING ECOTOXICOLOGY IN THE PICTURE S. Chelinho, CFE - Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; C. Venâncio, Department of Biology / Biology; L. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Sousa, University of Coimbra / Department of Life Sciences The recently adopted EU Circular Economy Package intends to boost the production and EU movement of fertilizing products, such as those obtained from urban wastes (UWF) and the harmonization of quality standards (certification) for such products, to avoid market rejection. The Portuguese and EU regulation on UWF production/commercialization relies on physico-chemical and biochemical analysis, which do not give any insight on the fraction of contaminant/mixture of contaminants bioavailable for organisms, nor the existence of potential antagonistic and/or synergistic effects. The main objective of this study is to develop an environmental quality certification system for the use of UWF in agricultural systems. In the present contribution, it was intended to characterize the ecotoxicological potential of the selected UWF, by evaluating both soil habitat and retention functions using lower-tier laboratory tests. Five UWF, two with origin in source separated organic wastes (group I; theoretically with higher quality, ex. lower metal content) and three originated from the organic fraction of mixed source separated organic wastes (group II; theoretically with lower metal content) were tested using a battery of standardized ecotoxicological assays with plants, soil invertebrates and freshwater species. Five soil-UWF dilutions (0.7; 2.1; 6.3; 18.9; 56.7%) and eluates of pure UWF were used as test-medium. The results show that the highest and lowest toxicity were observed in the two UWF from group I. Among soil organisms the range of sensitivities was: E. andrei > F. candida > E. crypticus > L. sativa > T. aestivum while for aquatic organisms was: H. viridisissum > R. subcapitata > C. vulgaris > H. incongruens > B. calyciflorus. The observed toxicity was probably related with UWF high salinity rather than with metal contents. The obtained data also reinforce the need to include information from biological susceptibility of the receptors potentially at risk on the available regulation to obtain a more realistic view of the potential risks and to adapt the UWF application practices. Ultimately, a sustainable economic growth based on the efficient use of resources/ waste valorization can be promoted.

WE421 Chemical and Ecotoxicological Assessment of Reclaimed Asphalt for their Subsequent Use V. Jančar, M. Buckova, R. Lichinsky, J. Hegrova, J. Huzlík, K. Effenberger, Transport Research Centre Reconstruction and repair of the road infrastructure are a source of the reclaimed asphalt, which is suitable to continue to use. It is also necessary to deal with the environmental impact of these materials within their ongoing life cycle, except testing their mechanical properties. Currently, the environmental impact tests of reclaimed asphalt are carried out in crushed condition, according to the leachability test of granular materials with grain size Scenedesmus subspicatus, Spinapis alba, Daphnia magna were carried out in aqueous extracts. The results were compared with the legislation and were evaluated in terms of the content of the monitored substances and the type of test material.

WE422 Leaching tests - a useful tool for the environmental impact assessment of construction products N. Bandow, Federal Institute for Materials Research and Testing / Contaminant Transfer and Environmental Technologies; F. Jürgen, BAM Federal Institute Materials Research and Testing; U. Schoknecht, BAM Federal Institute for Materials Research and Testing Construction products and waste materials used for construction can be in contact with the environment and may release potential harmful compounds. Information on the total content of these substances in the product is not sufficient to assess its environmental impact since it does not consider realistic exposure conditions. Concerning the pathway to soil and groundwater by contact with rain or seepage water leaching tests are available. The aim of this presentation is to show exemplary results of existing leaching methods and underline the strength and weaknesses of this kind of test with selected examples of our work: Concrete roofing tiles with terbutryn were leached according to CEN/TS 16637-2 with permanent immersion into water and according to EN 16105 with nine immersion cycles each consisting of immersion and dry stages. The eluates were divided into subsamples for different parameters as pH, conductivity, total organic carbon, anions, cations and terbutryn. Concerning the assessment of this leaching data it is important to notice that the eluate concentration do not represent necessarily environmental concentrations. Thus, the concentration in the leaching test cannot simply be compared to limit values established in environmental or occupational standards. Further considerations are necessary including exposure scenarios and environmental pathways before leaching tests can be used in risk assessment.

Advances in monitoring and evaluating remedy effectiveness for in situ amendments in soils and sediments (P)

WE423 Assessment and management of stormwater on sediment recontamination: you don’t need to measure everything, just the right things J. Drygienniak, Texas Tech University / Department of Civil Environmental and Construction Engineering; M. Bajer, Texas Tech University / Department of Civil Environmental and Construction Engineering; M. Bejar, Texas Tech University; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; D. Athanasiou, Texas Tech University / Civil, Environmental, and Construction Engineering; D.B. Rebble, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; G. Rosaen, South Dakota State University / Department of Civil Engineering; M. O’Malley, U.S. Navy Sparaw Systems Center; M. Colvin, SPARAW Systems Center Pacific R. Pitt, The University of Alabama; E. Strecker, B. Steeets, M. Otto, Geoysentec Consultants Stormwater sources are difficult to understand because of the poor characterization of the irregular, event-driven inputs and the difficulty of managing diffuse sources of large volumes of runoff. The study objective is to develop methodologies to quantify the consequences of ongoing low-level sources on chemical concentrations, contaminant availability, and effects on biological receptors in surficial sediments. The study area was in Paleta Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and chemical analysis. Receiving and outfall waters collected using auto-samplers, which were triggered at each location during two different seasons. The samples were analyzed for a variety of metals, PAHs, and PCBs, as a function of particle size. Sediment traps and sediment cores were also collected from the Creek and subjected to bulk chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050A and 3050B, respectively. The metals were analyzed using ICP-MS and MERX-T. Persistent organic pollutants in water samples were Liquid-Liquid Extracted (LLE) using the modified EPA Method 3510C, while sediment was extracted by Pressurized Fluid Extraction (PFE with ASE 350) using the modified EPA Method 3545A. PAH analysis was performed on HPLC and PCBs on GC/MS. Results showed that storm-events were dominated by coarse particles initially most likely to lead to sediment recontamination in the near field of the receiving water (e.g., PAH, and Cd). Cu was associated to the dissolved and clay fraction, however the depositing loads were more influenced by resuspension and redistribution of sediment than stormwater. Data suggested that PAHs and PCBs, due to low bioavailability as determined with passive sampling and bioaccumulation testing, are not a strong contributor to sediment toxicity which appeared to be better correlated to the presence of herbicides in the tested samples. This indicated that the size-segregated contaminant loads and simultaneous receiving water measurements were very helpful in relating the stormwater discharges to sediment recontamination. The particle associations in stormwater along with spatial distribution particularly in sediment traps, and less in the sediment cores, can identify contributing locations, effective remedial approaches, and help to propose best practices for stormwater and sediment management.

WE424 Development of active capping materials for oil spill contaminated sediment remediation L. Hauge, Norwegian Geotechnical Institute; P. di palma, IRSACNR; C. Riccardi, INAIL; E. Ezk, s.e. hale, Norwegian Geotechnical Institute; p. viotti, Università La Sapienza; M.P. Papini, Università La Sapienza / Chemistry Petroleum is extensively used for making oil-based chemical and energy; its daily
consume is on average 20 million tons and this is not predicted to decrease. The increasing use of the petroleum is inevitably connected to an increase in oil spills. Oil spills can occur for many reasons including human error or equipment failure and whenever an oil spill occurs it can represent a worldwide environmental problem. Effective remediation strategies are required. The aim of this study is to develop different sorbent materials for the active capping of oil spill contaminated sea-sediment. The experimental investigation was performed on an oil spill contaminated sea-sediment. Different sorbent materials were tested for the active capping: a commercial Activated Carbon (AC) Carbonatia, an organophilic clays (OC) CETCO Inc. and a biochar (BC). The sorption properties of the materials were first investigated in aqueous solution by performing equilibrium tests (isotherm) using a mixture of polycyclic aromatic hydrocarbons (PAHs) as target contaminants. The bioavailable concentration was assessed by using polyethylene glycol (PE) (26 µm) passive samplers. Capping experiments were performed in glass cylinders, where a layer of contaminated sediment (7.5 cm) was capped with a layer of 3 cm of sand mixed with the different tested materials (AC, OC and BC) and synthetic seawater (4 cm) on top. The capping efficiency was assessed by using polydimethylsiloxane (PDMS) fibers as passive samplers. The PAH profiles in the different capping systems were compared in order to assess the capping efficiency. Biochar showed a greater capping efficiency than activated carbon and organoclay. For example, anthracene porewater concentrations in the first centimetre of capping material, were reduced by 69%, 56% and 99% respectively for activated carbon, organoclay and biochar after 1 month. The porewater concentrations were also used to model the long term (>12 months) behaviour of various cap configurations with a numerical simulator. These were used to demonstrate that biochar can cost-effectively provide an alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

WE425

PCB Tissue Concentrations and Benthic Community Impacts at a Carbon Amendment Pilot Study in the Intertidal and Subtidal Zones of San Francisco Bay

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Historical site activities at the Hunters Point Naval Shipyard (HPNS) in South San Francisco Bay resulted in the release of chemicals, including polychlorinated biphenyls (PCBs), to offshore sediments. To inform remedy selection at this urban site, activated carbon (AC) amendments alternatives were evaluated in a pilot treatability study. Two 0.4 acre plots extending from the intertidal to the subtidal zone were treated with either AquaGate + PAC™ or Sediment™ were assessed for their potential to reduce ecological risks associated with PCB-contaminated sediment. Previous PCB studies indicated that reducing the bioavailability of PCBs to the benthic clams (Macoma nasuta) in shallow intertidal sediments when aided by mechanical mixing. This study assessed the effectiveness of AC placements without mechanical mixing in deeper water that is more representative of conditions where full-scale remediation is expected. Tissue bioaccumulation, benthic invertebrate community composition, and chemical analysis were measured to determine that biochars can cost-effectively provide an alternative to the more widely used sorbent materials for capping oil spill contaminated sediments. Comparisons were made between baseline, reference, and post-amendment conditions (8 and 14 months post-placement). PCB tissue concentrations in Macoma sp. were measured in situ (field) and ex situ (bench-top) after 28-day exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and then retrieve the sediment and exposed organisms for chemical analysis was a challenging task. Modifying a chamber design used in previous studies by Luthy et al. (2009) proved successful. Test organisms were another challenge. Tissue bioaccumulation was planned to be conducted with M. nasuta but instead, initial measurements were made with M. secta (white sand clam) collected at a nearby reference location where M. nasuta had been previously found. The species have a similar appearance and life histories but M. secta had low survival in the field (<20%), lab exposures (<60%), and lab controls (10%). Additional field pilot testing led to the use of M. nasuta from a supplier for post-amendment monitoring. PCB tissue concentrations were reduced by up to 85% in both pilot amendment areas after 14 months with clam survival greater than 90%. Benthic invertebrate communities in test plots were not significantly different from baseline conditions or among treatments 14 months after AC deployment.

WE426

Remediation of mine wastes with biochar: effect on metal bioavailability to earthworms

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Díez-Ortiz, Leitat Technological Center

The impact of two biochar-based amendments (one from pruning trees and other from sewage sludge) in metal toxicity and bioavailability was assessed in an acid (A) and an alkaline (B) mine waste before and after incubation under different simulated field conditions (irrigation versus drying flooding periods). Metal CaCl₂-extractable fraction, survival and metal tissue concentrations in the earthworm Eisenia fetida exposed to bulk (mine wastes) were measured. Survival of E. fetida was recorded after 21 days of exposure to six serial dilutions of mine wastes mixed with uncontaminated Lufa 2.2 natural soil containing waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and internal tissue metal concentration in surviving earthworms were measured. No signs of toxicity and no significant effects on survival of the organisms were observed in alkaline mine waste B. In contrast, exposure at time 0 to untreated acid mine waste (A) caused a 71% of mortality. The addition of biochars decreased toxicity in mine waste A and Cd internal concentrations in surviving organisms, indicating a lower metal bioavailability. Over time survival in the untreated acid mine waste increased and internal metal concentrations of the organisms decreased. No significant differences observed among treatments and incubation conditions. A strong decrease in Cd, Zn and Pb CaCl₂-extractable fractions was observed in all the mine waste dilution in both biochar treatments comparing to untreated mine waste, with no significant differences among treatments or flooding conditions. Addition of biochars also leads to an increase in the pH, which might explain the reduction in metal bioavailable fraction and the consequent decrease in organisms’ body metal bioaccumulation.

WE427

Remediation of mine wastes with biochar: effect on metal bioavailability to Earthworms

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Díez-Ortiz, Leitat Technological Center

The overall effect of two biochar-based amendments (one from pruning trees and other from sewage sludge) and their efficacy for metal immobilization in an acid (A) and an alkaline (B) mine wastes were assessed. Two different simulated field conditions, irrigation periods versus alternating flooding-drying periods, were evaluated before, immediately after and after 10 months of incubation. Besides physicochemical characterization, ecotoxicological assays with Enchytraeus crypticus exposed to both: i) pore water solutions extracted from mine wastes and ii) bulk mine wastes were conducted to provide a more accurate estimation of metal bioavailable fraction and risk of exposure. Survival of E. crypticus exposed to mine waste pore water solutions in an inert quartz sand matrix was evaluated after 10 days of incubation. No significant differences between different type of biochars were found. Our results showed that biochar treatments decreased the bioavailable fraction of Pb, Zn and Cd in the soil solution, reducing the toxicity of the acid mine waste to earthworms.

WE428

Bioavailability-based Methods to Assess Remediation Effectiveness

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Compared to the total chemical concentration, bioavailability is a better measurement of risks of hydrophobic organic contaminants (HOCs) to biota in contaminated soil or sediment. Many different bioavailability estimation methods have been introduced to assess the effectiveness of remediation treatments. However, to date the different methods have rarely been evaluated against each other, leading to confusions in method selection. In this study, four different bioavailability estimation methods, including solid phase microextraction (SPME) and polyethylene passive sampling (PE) aiming to detect free chemical concentration (Cfree), and Tenax desorption and isotope dilution method (IDM) aiming to measure chemical accessibility, were used in parallel to estimate bioavailability. Tenax desorption indicated that AC may be a less effective remediation compared to PBCs after addition of different black carbon sorbents. Bioaccumulation into earthworm (Eisenia fetida) was measured concurrently for validation. Activated carbon or biochar amendment at 0.2-2% decreased earthworm bioaccumulation of DDx by 83.9-99.4%, while multi-walled carbon nanotubes had a limited effect (4.3-20.7%). While all methods correctly predicted changes in DDx bioavailability after black carbon amendment, passive samplers offered more accurate predictions. Predicted levels of DDx in earthworm lipid using the estimated bioavailability and empirical BCFs matched closely with the experimentally derived tissue concentrations. However, Tenax and IDM underestimated bioavailability when the available DDx levels were low. Our findings suggested that both passive samplers and bioaccessibility methods may be used in assessing remediation efficiency, presenting flexibility in method selection. While accessibility-oriented methods offer better sensitivity and shorter sampling time, passive samplers may be more advantageous because of their better performance and compatibility for in situ deployment.
WE429
Identification, Quantification, and Risk Assessment of Polycyclic Aromatic Hydrocarbons and their Polar Derivatives in Soil After Steam Enhanced Extraction
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Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants produced from the incomplete combustion and pyrolysis of organic matter, and are among the major contaminants in soils. Steam enhanced extraction (SEE) is an in situ thermal remediation technique that uses the addition of steam to soil to increase the subsurface to increase the removal efficiency and recovery of volatile and semi-volatile contaminants, like PAHs. However, there is limited research on the formation of PAH derivatives during SEE of PAHs. Polar PAH derivatives are more mobile in the environment than PAHs, and some are more toxic than corresponding PAHs. There is an urgent need for analytical methods that can accurately quantify PAH derivatives in complex matrices, to better understand the chemistry occurring during SEE, and how it interferes with the remediation of soils.
In this study creosote-contaminated soil from the Wyckoff/Eagle Harbor Superfund Site in Washington, USA was thermally treated with laboratory-scale SEE. Soil pre- and post-SEE, effluent collected during SEE, and pre- and post-SEE leachate samples (mimicking rain runoff and groundwater) were collected and analyzed with gas chromatography-mass spectrometry (GC/MS). Lor PAHs, polar PAHs, and MW302-PAHS (n=97). Most of analyzed PAHs were quantified in all pre-, post- and effluent samples. PAHs decreased significantly, while polar PAHs increased in mean concentration post-SEE soil. Mass balances were estimated for different PAHs, and some were above 100%, indicating the potential formation of PAH derivatives during SEE. These findings suggest that SEE pilot and treatability studies should include polar derivatives to risk assessments to assess the full effectiveness of SEE and prevent understimation of potential risks. A quantitative risk assessment will be performed by calculating B[a]P concentrations and estimated lifetime cancer risk (ELCR) ingestion estimates. Developmental toxicity testing will be conducted with dechorionated zebrafish (Danio rerio) embryos (n=32/treatment) placed into 96-well plates containing pre- and post-SEE soil, effluent, and pre- and post-leachate extract samples at 6 hours post fertilization. Developmental toxicity will be assessed by evaluating morphological changes, embryonic/larval photomotor behavior, and mortality at 24 and 120 hours post fertilization. This study quantified PAH derivatives after SEE, and it will identify implications for risk assessment and developmental toxicity outcomes.

WE430
Enhanced total petroleum hydrocarbon removal without soil disturbance by serial surfactant foam spraying
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Fuel spills are a complex environmental problem. GC/MS Lor PAHs, polycyclic aromatic hydrocarbons are readily biodigested in the natural soil system. Diesel includes recalcitrant hydrocarbons to the natural degradation and may act as potential and actual sources of harmful human and ecological effects. The purpose of the study was to evaluate serial surface foam spraying technology, which avoids disturbing the soil, to deliver chemical oxidant and oil-degrading microbes to unsaturated soil. Hydrogen peroxide was used as a pre-surfactant biaugmentation. All oxidants were applied to the surface soil by surfactant foam spraying. Surfactant foam would be a good media to spread remediation agents to the surface of contaminated sites with less labor or energy. Surfactant foam was sprayed once onto diesel contaminated soil for oxidation of soil total petroleum hydrocarbon (TPH). Periodic biaugmentation foam was sprayed every three days for biodegradation of soil TPH. Foam spraying employing oxidation-bioaugmentation serial application significantly reduced soil TPH concentrations to 550 mg/kg from an initial 7470 mg/kg. Application of hydrogen peroxide by foam spraying increased the infiltration of hydrogen peroxide into the unsaturated soil. The easy and even infiltration of remediation reagents increased the contact with contaminants, resulting in enhanced oxidation and biodegradation. Fractional analysis of TPH showed C18-C22 present in diesel as biodegradation recalcitrant hydrocarbons. Recalcitrant hydrocarbons were reduced by 92% using oxidation-biodegradation serial foam, while biodegradation alone only reduced the recalcitrant fraction by 25%. (This work was supported by National Research Foundation of Korea (NRF-2015R1D1A1A01059664)).

WE431
 Factors affecting sorption of halogenated phenols to polymer/biomass-derived biochar: Effect of pH, hydrophobicity, and depoptronization
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High performance biochar synthesized via co-pyrolysis of polymer and rice straw (RS) was evaluated as a sorbent for ionizable halogenated phenols. Compared with RS-derived biochar, the sorption of 2,4-dichlorophenol (DCP), 2,4-difluorophenol (DFP) to polymer/RS-derived biochar was significantly enhanced by changing properties of biochar due to polymer residues, probably via hydrophobic sorption and electron donor-acceptor interactions. Removal of polymer residues and increasing aromaticity of polymer/RS-derived biochar at elevated pyrolysis temperatures affected the sorption capacity of halogenated phenols. Surface charge of biochar and deprotonation of the halogenated phenol molecules were other factors to be responsible for the sorption to polymer/RS-derived biochar. Competition with other halogenated phenols and dissolved cations implied that similar sorption mechanisms were existed and that surface complexation and electron donor-acceptor interactions were involved in the sorption to polymer/RS-derived biochar. Our results suggest that co-disposal of biomass and thermoplastic wastes through pyrolysis may be an effective option to produce a high-performance upgraded biochar as a sorbent for various types of contaminants.

WE432
Biochar for soil management: interactions with legacy contaminants and current-use pesticides
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Biochar (BC) is a product of thermal decomposition of biomass under oxygen-limited conditions. BC has received extensive attention because of its multifunctionality for gas uptake by capillary action, its excellent sorption properties make BC a valuable sorbent in the treatment of solids contaminated with hydrophobic organic compounds (HOC) and wastewater. Due to its assumed stability, BC is considered an environmentally compatible approach for carbon sequestration and thus, climate change mitigation. Its application to agricultural soils has been shown to increase soil fertility, mainly due to improved microbial activity and improved carbon availability, protection of microorganisms, and increased water holding capacity. Despite these benefits, very little BC is currently utilized as soil amendment, mainly because the mechanisms improving soil health are poorly quantified and understood. Besides, there are several concerns and unknowns for BC agricultural application: i) the presence of pollutants (HOC, heavy metals, originating in pyrolysis or feedstock; ii) lower density resulting in transport of BC and BC-associated pollutants into surface water bodies; iii) substantial reduction of efficacy of agrochemicals; iv) effect of BC stability during weathering on its application potential, particularly long-term fate of agrochemicals. In this study, the role of BC in the management of contaminated soils and in the management of pesticide-treated agricultural soils is addressed. A systematic approach is devoted to the positive effects of biochar on the efficacy of toxic contaminants and the ambiguos effects of reducing bioavailability of intentionally applied current-use pesticides. For that purpose, two different biochars were applied at increasing doses to soils amended with DDE and with epoxiconazole and tebuconazole as representative of legacy contaminants and broadly used fungicides, respectively. Bioavailability was assessed by means of solid-phase microextraction as a model eco-toxicologically relevant organism. The influence of biochar properties and biochar dose was considered. At the same time, the well-being of earthworms in biochar-amended control soils was detected. This study aimed at balancing the dosing of biochar in soil management to ensure both an efficient and sustainable control of diffusive contamination and of pests.
adoption capacity the material was 40% in nature, reaching a value of 78.4% after modification, deteriorating the feasibility of the process and material.

WE434 Field sampling and ex-situ bioassays for assessing the ecotoxicological risk of trace elements in different rehabilitated bauxite residues E. Di Carlo, R. Courtney, University of Limerick / Department of Biological Sciences & The Bernal Institute; A. Boulemont, RioTinto; L. Potratz, Alteo-Alumina

Bauxite residues are the by-product of the aluminium industry, resulting from the extraction of alumina from bauxite ore through the Bayer process. They could pose an environmental risk mainly because of their alkaline nature and the presence of trace elements (TE). For their rehabilitation in agronomic or phytostabilization for industrial use, understanding their leaching potential seems to be a promising, cost-effective and non-resource intensive option. However, there are still few studies evaluating the long-term success of the rehabilitation programmes and most of them do not consider ecotoxicology. The present study aims at assessing the success of rehabilitation strategies for bauxite residues considering the ecotoxicological risk of TE to organisms that live in the rehabilitated areas.

To this end, two approaches were adopted: field sampling and ex-situ bioassays. On the one hand, samples of bauxite residues, plants and soil macroinvertebrates were collected from a range of field sites, over different seasons, and the environmental concentrations of TE were measured through ICP. On the other hand, exposure tests with earthworms (following OECD guidelines) and RHIZOtest (ISO 16198) with three herbaceous species were carried out, under controlled laboratory conditions, to investigate the bioavailability of TE. Data from the field represent the first step to understand whether there is a possible ecotoxicological issue for wildlife. Comparing the TE concentrations measured in the environment with the literature thresholds, some problematic elements (such as V) and sites (such as the one with compost capping) are identified. Regarding the laboratory bioassays, data show that the bioavailable fraction (taken up and accumulated by both plants and earthworms) does not always correlate with the chemical assays, indicating the inadequacy of chemical methods when comes to evaluate the ecotoxicological risk. In conclusion, the outcomes of this research are likely to shed light on the bioavailability of TE in a complex matrix, such as bauxite residues, and to provide a more realistic risk assessment for the organisms living there. The findings of this research were supported by a FI grant from MINECO/FEDER EU.

Ecotoxicology of micro and nanoplastics: Mechanistic approaches to understand their risk for the environment and human health (P)

TH001 Synthetic textile fibers end up in agricultural soils - Can these microplastics pose a threat on soil organisms? S. K. Song, University of Helsinki / Department of Ecological Sciences; C. Van Gestel, Vrije Universiteit Amsterdam / Ecological Science

An important route of microplastics (MPs) to the environment is the release of synthetic textile fibers to waste water due to laundry. The major part of the fibers is retained in the sewage sludge during waste water treatment and ends up in green spaces and agricultural fields. In this study, we explored the accumulation and effects of polyester fibers in soil invertebrates upon exposure at concentrations of 0.02%, 0.06%, 0.17%, 0.5% and 1.5% of PES fibers in dry Luva 2.2 soil. The fibers were mixed in with the soil to achieve a homogenous mixture as possible. Polyester fibers in soil affected the survival and reproduction of the enchytraeid worm Enchytraeus crypticus, but the effects did not show a consistent dose-related pattern. Compared to the control soil, the survival was decreased at fiber concentrations of 1.5% and 0.5%, whilst the reproduction was decreased in all other treatments except for the 0.06% concentration. Polyester fibers did not affect the survival and reproduction of the springtail Folsomia candida and the oribatid mite Opilia nitens, the survival and feeding activity of the woodlice Porcellio scaber, nor the survival of the earthworm Eisenia andrei. Some of the measured endpoints seemed to show a negative response to the fibers, but the variation within the treatments was high, possibly also because it was difficult to achieve a completely homogenous distribution of the fibers in the test soil. The results of this study indicate that synthetic textile fibers can have slight negative effects on soil-dwelling enchytraeid worms, whilst arthropods were not markedly affected by the fibers. However, not only enchytraeid worms (E. crypticus), but also isopods (P. scorpiodes) and mites (O. nitens) showed a slight decrease in their reproduction. The extent of accumulation was not related with the fiber concentration in the soil. As the accumulation of microplastics in soils is evident, the effects of different types of microplastics and their possible role as carriers of xenobiotics to soil organisms need to be further investigated. This study is part of the project IMPASSE – Impacts of Microplastics in Agro Systems and Stream Environment.

TH002 Effects of microplastic particles of polyhydroxybutyrate towards photosynthetic aquatic organisms M.G. Peiter, Universidad Autónoma de Madrid; G. AMARIEL, Universidad de Alcalá; M. Tamayo-Belda, Universidad Autónoma de Madrid; F. Leganes, Universidad Autónoma de Madrid / Biology; R. Rosal, University of Alcalá; F. Fernandez-Pilhas, Universidad Autónoma de Madrid / Biology

Nowadays, the ecological impact of microplastics in freshwaters is not well understood [1]. Here, we have investigated the effects of microplastic particles (nominal size 5 mm) of polyhydroxybutyrate (PHB) in two organisms representative of freshwaters, the filamentous cyanobacterium Anabaena sp. PPC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and we have evaluated their potential degradability by the organism. Then, we have evaluated the biological effects of PHB on cellular growth, pigment content and several physiological parameters (metabolic activity, formation of intracellular reactive oxygen species and cytoplasmic membrane) in both photosynthetic organisms by flow cytometry using several fluorochromes. The results indicate that PHB released nanoparticles. NTA allowed to analyze the abiotic depolymerisation of PHB after 72 h in MillQ finding a wide range (75 - 300 nm) of PHB nanoparticles. PHB induced a decrease in cellular growth and chlorophyll content in both photosynthetic organisms. Furthermore, PHB induced an increase in the level of intracellular reactive oxygen species and induced changes in membrane potential. In conclusion, microplastic particles of PHB exhibited toxicity to photosynthetic organisms. Therefore, we are calling for a wide range of nanoparticles as a consequence of its own abiotic depolymerisation.


TH003 Differential responses of biomarkers in tissues of the blue mussel Mytilus edulis exposed to microplastics at environmentally relevant concentrations M. Revel, Catholic University of the West / UBL, Mer Molecules Santé; I. Lagarde, Institute of molecules and materials of Le Mans / Institute of Materials and Physical Sciences, EaT; A. Boullemant, RioTinto; L. Poizat, Université Catholique de lOuest / UBL, Mer Molecules Santé

Since the early 1970s, the occurrence of floating plastic has been reported in marine waters with great accumulation in gyres. In recent years, the presence of plastic debris < 5mm called microplastics (MPs) which result mainly from macroplastic’s fragmentation has also been reported in aquatic ecosystems even in remote areas. Several studies have reported the abundance of MPs and their effects in marine organisms. However, it appears necessary to investigate their potential toxicity especially at environmentally relevant concentrations. The aim of our study was to evaluate the bioaccumulation and toxicity of polypropylene (PP) and polystyrene (PS) fragments towards the blue mussel Mytilus edulis. These polymers were selected according to a previous study conducted in situ in the Region Pays de la Loire. Mussels were exposed in laboratory during 10 days at two environmentally relevant concentrations of 0.008 and 10 µg/L (9 and 11.250 particles/L respectively) (Desforges et al., 2014), and to a higher concentration of 100 µg/L (112 500 particles/L) of each MPs type. The exposure was followed by 10 days of depuration in clean seawater (without MPs). MPs fragments were prepared in the laboratory from commercially available products by milling; characterized in terms of size, shapes and they were counted. Following exposure, tissues and biodeposits (faeces and pseudofaeces) were chemically digested and analyzed for MPs recovery of size, shapes and they were counted. Following exposure, tissues and biodeposits of faeces and pseudofaeces of mussels were collected from a range of field sites, over different seasons, and the environmental concentrations of TE were measured through ICP. The presence of PE and PP particles in digestive glands of mussels exposed to 100 µg/L of MPs were observed at all tested concentrations. MPs were observed at all tested concentrations. Significant increases in SOD and CAT activities were observed in the digestive glands of mussel’s exposed to 0.008 and 10 µg/L and in gills from mussels exposed to 100 µg/L of MPs that could be indicative of an oxidative stress. This study brings new results on the potential sublethal effects of MPs at environmentally relevant concentrations of MPs.

TH004 Effects of zebrafish exposure to high-density polyethylene and polypropylene microplastics at molecular and histological levels G. Limoner, University of Siena / Department of Physical Sciences, Earth and Environment; A. Mancia, L. Abelli, University of Ferrara / Department of Life Sciences and Biotechnology; M. Fossi, C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment

Aluminum “bauxite” ores are mineral deposits that are extracted to produce aluminum metal. The most common contaminant is alumina (Al2O3) which is removed from the ore by Bayer’s process in order to remove iron and silica from the ore. The by-product is the bauxite residue, a soil-like material that contains high levels of Al and Fe. Bauxite residues are the by-product of the aluminium industry, resulting from the extraction of alumina from bauxite ore through the Bayer process. They could pose a risk to human health, the ecosystem, and the environment. Bauxite residues are rich in metals such as Al, Fe, and Si, which are essential for human health. However, high concentrations of these metals can be toxic to humans and other organisms. Some studies have shown that bauxite residues can have toxic effects on aquatic organisms, including fish and molluscs. However, the mechanisms behind these effects are still unclear.

In this study, we evaluated the toxicity of bauxite residues to zebrafish (Danio rerio) using a microplate assay. Zebrafish embryos were exposed to different concentrations of bauxite residues and the effects on their survival, growth, and development were measured. The results showed that bauxite residues had a significant negative impact on zebrafish development, with higher concentrations causing more severe effects. These findings suggest that bauxite residues may pose a risk to aquatic ecosystems and may have implications for human health.

In conclusion, our study provides new insights into the potential toxic effects of bauxite residues on aquatic organisms, particularly zebrafish. These findings highlight the need for further research to better understand the mechanisms behind these effects and to develop strategies to mitigate the risk of bauxite residues to the environment and human health.

References:
Due to the constant increase of plastic use and production, microplastics (MPs) have become a contaminant of serious concern for the marine environment. However, detailed information about biological pathways affected by the exposure to different MP polymers is still lacking, in particular at transcriptome level. The present study focused on the identification of the molecular pathways affected by a chronic exposure of zebrafish (Danio rerio) to different concentrations of a commercial blend of two environmentally relevant MPs for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and polystyrene microplastics (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next-generation sequencing techniques using Illumina technology. In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microplastics affected the liver transcriptome in a dose-dependent way, inducing the differential regulation of specific suites of genes. Histological analyses evidenced changes in the inflammatory response occurring at the two mucosal tissues selected for observation. The correlation of histological alterations with differential gene expression will be addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.

TH005 Uptake and Effects of Synthetic and Natural Microparticles in the Shrimp Palaeomon varians
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Microplastics (< 5 mm) have become ubiquitous in waters. The smaller they are the easier they can be taken up by aquatic organisms. Once ingested they can cause various harmful effects. This study investigates the effects of different sizes of artificial and natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palaeomon varians). The study includes feeding experiments with different sizes of fluorescent microplastic particles, nanosized titanium dioxide particles and silica powder of diatoms as a reference for natural particles. The uptake and distribution of particles in the digestive organs was observed by fluorescent microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the midgut glands of animals which were fed with particles from 2 to 48 hours. The larger particles (2 µm and 10 µm) remained in the stomach and in the lumen of the gut. The smaller particles (0.1 µm) were translocated into the supraglandular tissue of the midgut gland. Decapods have a stomach with fine-filtered structures which prevent the uptake of particles > 170 nm into the digestive gland. Superoxide dismutase activity was rapidly induced when the animals were exposed to 0.1 µm plastic particles. The activity increased within 2 hours after microplastic ingestion and remained high after 48 hours. Slight difference appeared between natural and synthetic particles. The diatom powder also induced SOD activity which, however, continuously decreased with time. Due to the enzyme cascade where SOD reacts first, the activity of catalase was clearly lower. It can be assumed that any particles < 170 nm enter the cells of the midgut gland and induce oxidative stress. Following optical detection of reactive oxygen species (ROS) via confocal laser scanning microscopy will help to identify cellular reactions after exposure to microparticles.

TH006 Microplastics in the sub-surface layers of the South Atlantic Ocean
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Microplastic particles in the ocean is a major environmental concern. Most studies tend to concentrate on the ocean surface when examining microplastic pollution. However, it is known that, for various reasons, microplastics can lose buoyancy and sink. Large plastic items are known to physically block the intestinal passage, exert physical damage, impair food uptake and/or cause false satiation. Whereas, the biological effects resulting from ingestion of smaller micro-sized particles or microplastics (MPs) are considerably less documented and potential (negative) consequences on the aquatic fauna are largely unknown. To address this, we designed a study aimed at assessing how ingestion of MPs can affect physiological function of the intestine in fish. We hypothesized that ingestion of MPs cause inflammatory responses and disturb intestinal barrier and transporting functions. Juvenile rainbow trout (Oncorhynchus mykiss) were exposed via diet to polystyrene (PS) particles (50-250 µm, 10mg of PS MPs/fish/day) for a period of 4 weeks. Fish were fed four types of diets: control (no PS MPs) and diets containing untreated PS particles (PS–virgin) or pristine manufactured MPs (PS–manufactured) and secondary MPs which result from the fragmentation of plastic items, including fish. Biochemical responses and histological effects resulting from foodborne exposure to post-consumer microplastics in juvenile Solea senegalensis. M. Martins, Faculty of Sciences and Technology, Universidade Nova de Lisboa / Dep. Science and Environment; P. Sobral, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; C. Gonçalves, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; P. Sobral, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / DCEA; M. Costa, MARE - Faculty of Sciences and Technology Universidade NOVA de Lisboa / Department of Environmental Sciences and Engineering
Microplastics (MPs) have dramatically increased in marine environments, being recognized as ubiquitous environmental pollutants. Two types of microplastics are usually detected in environmental samples: the primary MPs originally and intentionally manufactured MPVs and the secondary MPs which result from the fragmentation of dumped plastic items. The latter are normally referred as post-consumer microplastics and usually present different shapes, colors, composition and irregular surface. However, few toxicological studies have addressed exposure of marine organisms to post-consumer microplastics. The goal of the present research is to assess the effects of post-consumer microplastics in juvenile rainbow trout (Solea senegalensis), using diet as the microplastic vehicle. For this purpose, four distinct diets were prepared using commercial fish pellets incorporated with two MPs sizes (< 200 µm and 300-500 µm) and two concentrations of each (56 and 56 MPs per day) and other without MPs (control), making a total of five treatments. Sixty-day laboratory assays were conducted, in duplicate, and the test pellets were provided to fish once a day. After 14, 30 and 60 days, fish were sacrificed and each treatment was analyzed. The liver, gills, stomach and muscle tissue were analyzed and stored at -80°C for biochemical analysis. The digestive tract was also sampled and immersed in Davidson’s fixative for histopathological analysis. Biomarkers related to oxidative stress were analysed, namely the lipid peroxides, glutathione and the activity of catalase, superoxide dismutase and acetylcholinesterase. Histopathological analyses were also performed in the digestive tract to assess the presence of MPs and possible histopathological effects.

TH007 Effects of dietary microplastic exposure on fish intestinal physiology
G. Asmonaitė, H. Sundh, N. Askier, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences
The accumulation of plastics in digestive tracts of aquatic biota has been extensively documented and ingestion has been proposed as a prominent exposure route to both plastic debris for a variety of aquatic animals, including fish. Due to the constant increase of plastic use and production, microplastics (MPs) have become a contaminant of serious concern for the marine environment. Most studies focus on the determination of MPs at various sampling stations along the Atlantic Ocean (SAO) was determined. The study was conducted from the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next-generation sequencing techniques using Illumina technology. In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microplastics affected the liver transcriptome in a dose-dependent way, inducing the differential regulation of specific suites of genes. Histological analyses evidenced changes in the inflammatory response occurring at the two mucosal tissues selected for observation. The correlation of histological alterations with differential gene expression will be addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.
of Pacific whiteleg shrimp

Y. Chae, Konkuk University; D. Kim, Konkuk University / Department of Environmental Health Science; Y. An, Konkuk University / Department of Environmental Health Science

Because of enormous amounts of plastic wastes in marine environment, the concerns about marine pollution and ecological damages on marine organisms have increased. Especially, among these plastics, small sized plastic particles like microplastics (< 5 mm) and nanoplastics (≤ 100 nm) are getting a lot of attention because the researches about their impacts and effects in environments are under way. In this study, we assess various physical, biochemical and nutritional changes in the bodies of Pacific whiteleg shrimp (Litopenaeus vannamei) exposed to nanoparticles. For 21 days, shrimps were fed mussels (Mytilus edulis) contaminated with nanoparticles (44 nm diameter) and their physical (length, weight, water contents, body mass index), biochemical (catalase, CAT; glutathione s-transferase, GST; superoxide dismutase, SOD; fecal microbiota viability), and nutritional (crude lipid, crude protein, amino acids, and fatty acids) changes were assessed after exposure. In results, nanoparticles attached on the filter and ingested to mussels entered the bodies of shrimps and affected the health and physicochemical properties of shrimps. Especially, biochemical changes of lipopolysaccharides were significantly induced in the bodies of shrimps. These results can be the evidence of the impacts of small sized plastics on marine organisms. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and Future Planning (2016R1A2B3010445).

TH101

Brood Pouch-meditated Polystyrene Nanoparticle Accumulation During Daphnia magna Embryogenesis

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Nanoplastic debris is ubiquitously distributed in aquatic environments and are consumed by an extensive array of aquatic organisms across trophic levels. While ingestion of particles receives most attention, other routes of uptake and cellular uptake remain unexplored. Here, the planktonic filter feeder Daphnia magna was used to track routes of uptake and target tissue of polystyrene nanoparticles (PSNP). A sub-lethal concentration of 5 mg L⁻¹ fluorescent PSNPs (25 nm) was used to monitor accumulation in adult animals as well as their embryos in the open brood pouch. A time series throughout embryonic development within the brood pouch revealed accumulation of PSNP in lipopolipidic cells in the early stages of embryonic development while the embryo is still surrounded by a chorion and before beginning of organogenesis. In contrast, PSNP particles were neither detected in the gut epithelium nor in lipid droplets in adults. An ex vivoexposure of embryos to PSNP (1.5 ng/L) resulted in similar alterations in the development of embryos and PSNP uptake by embryos. Whether the observed brood pouch-mediated PSNP uptake ultimately translates to long-term effects under chronic exposure to environmentally relevant concentrations remains a challenging area for further research. By demonstrating embryo PSNP uptake via the brood pouch, data presented here give novel insights in biaccumulation of nanoparticles and likely other lipophilic contaminants. Since this uptake route can occur within a diverse array of aquatic organisms, this study warrants consideration of brood pouch-mediated accumulation in efforts studying the hazards and risks of nanoparticle contamination.

TH103

Effect of cationic amino (PS-NH2) polystyrene nanoparticles in brine shrimp Artemia franciscana nauplii: biochemical and molecular responses

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The accumulation of plastic litter on beaches and open oceans has been identified as one of the major threats in marine ecosystems worldwide. Laboratory experiments have proved that the formation of nano-sized plastics during the polymer degradation may reach marine ecosystem, considered as the most in danger. In present study, the effect of 50 nm cationic amino polystyrene (PS-NH2) was investigated in nauplii of Artenia franciscana, which is commonly used as aquatic model organism in toxicity tests. Acute toxicity tests were performed on nauplii of Artenia through sub-lethal suspensions of PS-NH2 (0.1, 1 and 10 µg/mL) in natural sea water (NSW) for 48 hours. The toxicity was evaluated by measuring growth and several biomarkers as carbonylesterase (CHE), glutathione-S-transferase (GST), cholinesterase (CH), heat shock protein (HSP70), lipid peroxidation (LPO) and catalase (CAT), involved in important physiological processes, such as biotransformation of xenobiotics, neuronal transmission and oxidative stress. The effects of PS-NH2 (0.1 and 1 µg/mL) on the expression of genes related to metabolism, biosynthesis and embryogenesis during the development of brine shrimp was also investigated. Genes included HSP26, HSP70, mitochondrial uncoupling protein 2 (UCP2), chaperon-containing TACP (TCP) and late embryogenesis abundant (LEA). Acute exposure to sub-lethal suspensions PS-NH2 caused a significant increase in growth in A. franciscana nauplii, as well as significant changes in all biomarkers studied, except for TCP. A significant up-regulation of HSP26 and HSP70 was observed in nauplii exposed to 1 µg/mL of PS-NH2 as well as the modulation of TCP, the latter not significant. This supports the results obtained from biomarkers, suggesting a stress response and potential effects on larval growth and development remain to be analysed. By taking other life stages into account and using a quantitative approach for analysing particle ingestion and egestion, this study contributes to enhancing the mechanistic understanding of microplastic – blue mussel interaction.

TH102

The sub-lethal impact of polystyrene microplastics and nanoplastics on the Mediterranean mussel M. galloprovincialis

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The contamination of marine environments by microscopic plastic debris is a current threat to the fitness of the exposed biota, and even higher concerns are risen on its potential fragmentation to the nanoscale. In the framework of the JPI OCEANS project PLASTOX, we investigated the chronic effects induced by a 21-day exposure to 1.5, 15 and 150 ng/L of polystyrene microparticles (MP, 3µm) and nanoplastics (NP, 50 nm) on the fitness of the mussel Mytilus galloprovincialis. To do so, we employed a multibiomarker approach encompassing immunological responses (lysozyme and phagocytosis), lysosomal endpoints (lysosomal membrane stability and neutral lipids), oxidative stress (catalase activity, malondialdehyde and lipofuscin content) and detoxification (glutathione S-transferase) parameters and neurotoxic effects (acetylcholinesterase activity). The lysosomal membrane stability, whose impairment is a known general stress symptom, was generally reduced in mussel hemocytes after exposure to both MP and NP, however, only in NP-treated mussels this effect was accompanied by a decreased phagocytic activity. Lysozyme activity in hemolymph was affected by both MP or NP treatments, suggesting a generalized impairment of the immune system efficiency. All the performed treatments led to an accumulation of neutral lipids in the mussel digestive gland. Moreover, an accumulation of malondialdehyde and lipofuscin was observed at 150 ng/L NP and at 1.5 and 150 ng/L MP. In gill, catalase was up-regulated following either MP (1.5 and 15 ng/L) or NP (1.5 ng/L) treatments, while a decreased acetylcholinesterase activity was noted only at 15 ng/L NP. Biomarker data were integrated in the Mussel Expert System (MES), which estimates the stress level induced on mussels by calculating a A-E Acute health status index (HSI). The MES did not identify health alterations in control and at 1.5 ng/L MP (HSI = A), while the onset of a low stress level (HSI = B) was detected at 15 and 150 ng/L MP. Differently, the stress level associated to NP (1.5 ng/L) was up-regulated at 1.5 and 15 ng/L NP and low at 150 ng/L NP. Overall, results show that both polystyrene MP and NP induce a chronic stress syndrome in mussels by affecting lysosomal integrity and generating pro-oxidant conditions. However, the two particle types can differentially alter immunological and neurological processes, with the exposure to NP resulting in a higher impact on the overall mussel fitness compared to MP.
apoptotic pathway following PS-NH₂ exposure. On the contrary, no significant effect on gene expression related to the brine shrimp’s metabolism (UCP2) was observed, and LEA was significantly modulated only at the lowest concentration tested. These findings indicate that stress-related responses are taking place in exposed nauplii after acute exposure to sub-lethal suspensions of PS-NH₂, and confirm the general concern about PS-NH₂ and their ability to represent an ecological threat for marine organisms. Given the increasing levels of plastic pollution in the oceans, additional studies should be done considering long-term exposure to analyze the potential risk of nano-sized plastics in marine environments.

TH014 The impact of nanoparticles on Antarctic krill Euphausia superba
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Under current climate change scenarios, Antarctic krill (Euphausia superba) is facing multiple stressors, which could affect its abundance and distribution. Microplastics have been recently reported in Antarctic waters, representing an additional potential impact on krill population. In this study we investigated the effects of model microplastics (< 1 µm) on krill juveniles through short-term exposure (48 h) of polystyrene nanoparticles (PS NPs) with different surface charge. The behaviour of anionic (60 nm PS-COOH) and cationic (50 nm PS-NH₂) NPs in Antarctic natural seawater (NSW, 34°S, 2°C) was also investigated by Dynamic Light Scattering. PS-COOH formed nanoscale aggregates (average size of 862 nm) in Antarctic NSW, while PS-NH₂ maintained their nominal size. No mortality was observed upon exposure to 2.5 µg/ml PS NPs after 48 h. However, krill exposed to PS-NH₂ showed lower motility than individuals exposed to PS-COOH and were characterised by significant up-regulation of a β6 gene involved in new formation of cilia for swimming. Similar alterations in microcrustaceans have been associated with mortality over long-term exposure. Both PS NPs also accumulated in faecal pellets (FPs), which were characterised by lower density and sinking rate compared to control. Our findings demonstrate that PS NPs are able to affect swimming behaviour, cuticle formation and FPs properties of Antarctic krill, with potential serious consequences on Southern Ocean food web and biogeochemical cycle.

TH015 Exposure to nanoplastics as a potential stressor on Mytilus galloprovincialis and Euphausia superba in the Southern Ocean
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Physical and chemical stress in the Southern Ocean marine environment is a worldwide problem, especially since plastic materials degrade into nano-size particles, becoming more bioavailable and constituting a source of entry of other contaminants into marine organisms. The present study aimed to assess the effects of polystyrene nanoparticles (PSNP) and clarify their modulation of short-term carbamazepine (cbz) toxicity on bivalve Mytilus galloprovincialis. Mussels were exposed for 96 h to PS NPs (100 nm, 100 µg/L) with different sizes of sodium carboxylate, sulfate and sulfonate end cationic, and different concentrations (100, 1000, 5000 µg/L). Molecular and biochemical biomarkers were evaluated in digestive gland, gills and hemolymph. Abundance of mRNA in digestive gland and gills revealed significant alterations in expression of genes associated with metamorphosis, DNA repair, cell stress-response and innate immunity. Combined exposure induced significant down regulation in gene expression when compared to individual exposure. Total oxidant status values suggest oxidative stress after exposure to 0.5 mg/L PSNP, whereas increased total antioxidan capacity and esterase activity suggest activation of antioxidant defenses after exposure to 50 mg/L. PSNP. Exposure to 0.05 and 0.5 mg/L PSNP induced effects on neurotransmission in hemolymph. In gills, almost all experimental exposures induced inhibition of AST and ALT values. Genotoxicity was found in hemocytes after exposure to PSNP; cbz and their mixture.

TH016 The role of microplastic size and type on PAH sorption and bioavailability to copepods
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It has been proposed that microplastic (MP) may act as a vector for a wide range of chemical pollutants already present in the environment. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous pollutants in the environment, known to cause adverse effects to a variety of marine organisms. Most PAHs have relatively high polymer-water partition coefficients, meaning their potential for sorption to, and transport by, MPs is high. In both field and laboratory studies, a broad range of marine species have been shown to ingest significant quantities of MP, with extended periods of retention observed in some cases. If PAHs are adsorbed to the MPs, this could present an alternative exposure route to PAHs for such species. However, the effect of MP sorption on PAH bioavailability in the marine environment remains poorly understood. Although several studies have attempted to study bioavailability of MP-adsorbed PAHs to aquatic organisms, most studies employ approaches that are not accurate enough to provide results from adsorbed compounds or fractions that have dissolved from the MPs into the exposure media. Here, we investigate the sorption kinetics and present adsorption isotherms for three model PAHs (fluoranthene, phenanthrene and 1,3-dimethylnaphthalene) to a range of different MPs in natural seawater. The selected PAHs exhibit different sizes and hydrophobicities, thus having varying solubilities (two to three orders of magnitude). In the case of the least soluble compound, fluoranthene, MP sorption could prove an important route of uptake in pelagic organisms. To account for the natural variability of MPs present in the marine environment, test materials with different sizes, shape (particles, fibres) and polymer compositions (polystyrene and polystyrene microbeads, polyester microfibres) were used. Using a novel approach, the influence of MP sorption on PAH bioavailability to two marine copepod species (Acartia tonsa and Calanus finmarchicus) was investigated using polystyrene particles with size ranges above and below the ingestion limit for the two species. The range of MP diameters used in the experiments was ~10-300 µm. Chemical body burden was measured after exposure to determine bioavailability.

TH017 Limited influence of microplastics on the effects of an endocrine disruptor on the African clawed frog (Xenopus laevis)
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Endocrine disruptors (EDs) are among the most potent contaminants under Arctic conditions affecting more than 40% of vertebrates like fish and amphibians but also humans. Tadpoles are not only vulnerable to ED, but potentially also to particulate contaminants like microplastics because they filter the surrounding water unspecifically during the first phase of their development. Until now, it is not clear if microplastics have negative impacts on amphibians and if they alter toxic effects of chemical contaminants like ED. This study focused on potential interactions of microplastics on tadpoles of the African clawed frog (Xenopus laevis). The aim of this study was to analyse (1) if microplastics alone can have negative impacts and (2) if the presence of microplastics increases the effects of an endocrine disruptor. The oral contraceptive 17α-ethinylestradiol (EE2) was used as model ED; polypamide (PA) particles in the size range of 15-20 µm (mean diameter) with an irregular shape were used as model MP. Tadpoles were exposed in batches with chronic exposure for 21 days to one concentration of EE2 (10^6 M) and a low and a high concentration of PA-particles (1 and 100 µg L⁻¹) separately and in combination with each other. Stress hormones and larval development as well as sexual differentiation were assessed by gross-morphology and histology. Biomarkers, e.g. vitellogenin, were analysed as EE2 specific endpoints. The concentration of EE2 in water was assessed using an LC-MS/MS analytical method. Physical effects of the microplastic particles themselves on larval development and sex differentiation were not observed. Only increased levels of the hepatic biomarker vitellogenin showed higher exposure of EE2 in treatments including PA particles in comparison to treatments without microplastics. All other EE2 specific endpoints were not influenced by PA particles. These results indicate that microplastics only play a minor role for the effects of a hormonal active chemical in amphibians and thus provide insights for an indepth risk assessment of MP in the environment.

TH018 Kinetics of POPs sorption and plastic additives release to a variety of polymers under Arctic conditions
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The PLASTOX project investigated the ingestion, food-web transfer, and ecotoxicological impact of microplastics (MPs), together with the persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems. PLASTOX combines field-based observations, laboratory tests and manipulative field experiments to study the ecological effects of MPs. The use of common microplastic reference materials, including a marine litter-derived MP produced from an environmentally weathered fish box, allows a meaningful comparison of data generated by different partners and across the different activities of PLASTOX. As part of a long-term field experiment conducted at marine locations across Europe (Mediterranean to
Characterization of microplastics present in personal care products and the study of its toxicity mixed with chlorpyrifos on juveniles of Solea senegalensis. G. Albeniz, Universidad de Cádiz (Spain) / Toxicology Area; I. Cabrera-Pozo, University of Cádiz / Toxicology Area; D. Coello, R. Rodríguez-Barroso, J. Quiroga, University of Cádiz / Environmental Technology; J. Arellano, University of Cádiz / Toxicology Area.

In the last decades, different components from personal care products have arrived in aquatic ecosystems because these products are not biodegraded or removed in wastewater treatment plants. Some of the personal care products contain plastic microbeads such as exfoliating shower gel, toothpaste and make-up. Creams commonly used and available in supermarkets of our area were used by these assays. The microphases available in these samples were separated and chlorinated. The particles were identified by Fourier transform-infrared (FT-IR) spectroscopy using a PerkinElmer Spectrum 100. The spectra are recorded in reflection mode in the spectral range 4000-650 cm⁻¹ by co-adding 128 scans at a resolution of 4 cm⁻¹, the particles were identified by comparing FT-IR absorbance spectra of the microplastics to those in a polymer reference library. The microplastics were used in toxicity test. In aquatic ecosystems and their organisms are exposed to complex mixtures of environmental contaminants as pesticides and microplastics. Thus, the effects of microplastics interaction with chlorpyrifos, an organophosphate pesticide, have been studied in this work. The toxicity studies were carried out during 96 hours with continuous ventilation and water renewal every 24 hours, at a temperature of 19-20°C and under 12h light/12h dark exposure. The juveniles of Solea senegalensis (weight 5.07 ±0.49 g) were exposed to five nominal concentrations of chlorpyrifos (5-80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/l; microplastics: 0.150 mg/l), microplastics alone (0.150 mg/l), plus an untreated control and a solvent control (acetone). In these assays not mortality was observed on juveniles with both compounds and their mixtures. Cholinesterases (ChE) have been used as specific biomarkers of harmful chemicals by filter feeders. Daphnia magna and are they significant vectors for hydrophobic organic pollutants? C. K. Frydkjær, Aalborg University / Biology and Environmental Science; N. Iversen, Aalborg University / Department of Chemistry and Bioscience; P. Roslev, Aalborg University / Biology and Environmental Science.

The presence of microplastics in aquatic ecosystems is of increasing global concern. Ingestion of microplastics may result in adverse effects in aquatic organisms, and in particular, an increased risk of bioaccumulation and biomagnification vectors for hydrophobic pollutants. This study investigated: i. the amount of regular and irregular shaped microplastics ingested and digested by the filter feeder Daphnia magna during exposure and gut clearance; ii. the adverse effect of microplastic with and without sorbed phenanthrene; and iii. the significance of phenanthrene sorption by microplastic compared to sorption by naturally occurring plankton organisms, and the present concentrations of microplastic particles. However, live and dead plankton organisms are likely more suitable vectors for hydrophobic pollutants than microplastics. This suggests a more limited role of microplastics as significant aquatic vectors for hydrophobic pollutants under current environmental conditions.

TH021
Microplastics as vector for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds M. Tesfai, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; C. Arnelmo, University of Gothenburg Sweden / Department of Biology and Environmental Sciences.

Plastic pollution is a recognized global issue and the ubiquity of microplastics (MPs) in aquatic environment is a cause for concern. Potential effects on organisms are still not fully understood, and mechanistic understanding, required to fully reveal consequences of exposure, especially in connection to chemical mixtures, is still lacking. Studies have shown other MPs have capacity to sorb and concentrate hydrophobic organic chemicals (HOCs) in the aquatic environment. There is an ongoing debate about MPs as vectors for chemical contaminants and their relative importance compared to other naturally occurring particulates. The goal of present study was to quantify particle-mediated chemical transfer and using biomarker approach examine associated biological effects in three spined stickleback (Gadus morhua). The effect of MPs, PP, PS, and silica particles (sili) exposed diets, enriched with PS particles (250µm) were conducted. Two types of synthetic polymeric particles (PE and PS) and non-plastic polymer particles (sili), which were selected as reference material, were used. Selected particles were loaded with three model compounds (benzo[a]pyrene, ethylenestradiol and chlorpyrifos) having distinct toxicological modes of action and different chemical properties. Eight different experimental diets: control diets (negative control), diets with clean particles (PE, PS, sili), diets containing particles spiked with a chemical mixture (PE-mix, PS-mix, sili-mix) and, finally, diets loaded with only chemical mixture (negative control) were developed. During the experiment, fish were fed daily (6% of body weight and 5 % particles) for a period of two weeks. Gene expression of established biomarkers of chemical transfer in fish. Differences could also be seen between particle types, where PS contaminated particles showed similar pattern with the non-particle, while PE contaminated particles resulted in a greater transfer of chemicals. The chemical control was for some treatments lower than the particle groups indicating a particle-mediated chemical transfer in fish.

TH022
Dietary exposure to polystyrene microplastics contaminated with environmental pollutants induce hepatic biomarker responses in fish G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; C. Arnelmo, University of Gothenburg Sweden / Department of Biology and Environmental Sciences.

In the field of microplastics (MPs) research, polystyrene (PS) particles have become relevant material not only for investigating the uptake of the particles, but also for assessing biological effects. There is a growing body of (eco)toxicological information, suggesting that PS MPs, in a range of nano to micro- meters (< 50µm), have a potential to impact aquatic organisms. On the other hand, there is an evident lack of toxicological information in regards to bigger size ranges of these particles (>50µm), at sizes, detectable in the environmental matrices. We conducted an experimental study aimed at elucidating effects resulting from dietary exposures to PS particles ranging in size 50-250 µm. In this study, juvenile rainbow trout (Oncorhynchus mykiss) were exposed diets, enriched with PS particles (10mg of PS particles/Fish/day) for 28 days. We used environmentally contaminated PS particles from in situ exposures from two environmental matrixes (undiluted sewage effluent and industrial harbor runoff). As PS MPs largely exceeded sizes relevant for biological uptake, it provided an opportunity to study particles’ role as vector for environmental pollutants. Three different experimental diets, containing PS, sewage (PS-sewage) and harbor (PS-harbor) exposed particles, were developed. Thereafter, a suite of oxidative stress biomarkers was investigated in the hepatic tissue of fish exposed to PS MPs via gene expression analysis (NRF2, GR, GST, GS, GPx, CAT, GCLmod, GCLcat, SOD) and enzymatic assays (GR, GST, GCL Cat). Additionally, mRNA levels of established biomarkers (CYP1a, ERα and β, AR, MT, VTG) were quantified to provide additional insights into xenobiotic-related hepatic responses to dietary PS MPs exposures. The findings of this study revealed an indication of NRF2-mediated oxidative stress regulation.
Fish from PS-sewage and PS-harbor treatments had altered expression levels of
multiple antioxidant enzymes in liver. Dietary exposure to PS MPs resulted in
low-level activation of hepatic oxidative stress, which may not necessarily exert
harmful effects on hepatic physiology, but may rather indicate adaptive
homeostatic regulation. Differential responses to different PS MPs treatments
(PS-sewage and PS-harbor) potentially could be explained by different chemicals
associated with particles during in situ exposures.
TH023
Effects of Nanopolystyrene and the Co-Contaminant Tributyltin on the
Nematode Community Structure in Sandy Sediments
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ISMERUQAR; A.J. Sweetman, Lancaster University / Lancaster Environment
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Infrastructure and Society
Nanoplastics (NPs, ≤ 1, µm) may result from larger plastic debris released in the
environment and can pose a risk to marine organisms and ecosystems. The risk of
NPs can be exacerbated because toxicants sorbed to NPs may be transported to and
become more bioavailable in organisms. It is likely that NPs are the most abundant
plastic particles present in marine environments, and as in the case of microplastics,
they are expected to accumulate in benthic ecosystems. However, there is no
information on the impact of NPs on benthic meiofauna assemblages. It is critical to
understand impacts of NPs on sediments of NPs because meiofauna communities
play key roles on ecosystem functions such as food production and nutrient cycling.
Nematodes are well established as pollution indicators and structural shifts in their
communities reflect environmental changes. The goal of our work was to assess the
effects of nanopolystyrene (nPS) and nPS with the sorbed co-contaminant
Tributyltin (TBT) on free living nematodes on sandy sediment within a mesocosm
experiment. Sediment was collected (up to 5 cm depth) at the Eden Estuary, St
Andrews, Scotland, UK. The mesocosms (12ºC) consisted of glass beakers (1 L)
and the exposure took place for up to 2 months. Core samples of sediments were
taken each week from the following treatments: 1) Control sediment, 2) Sediment
with spiked TBT (0-100 mg/kg), 3) Sediment with nPS (0-12 mg/kg) and 4)
Sediment with nPS spiked with TBT (0-10 mg/kg nPS). Oxygen penetration depth
(OPD) was determined by measurement of the oxygen saturation in the sediments
using a microprofiler equipped with oxygen microsensors. Changes in the
nematode community structure were measured by assessment of changes nematode
diversity (nematodes identified to genus) and dose responses analysed according to
nPS and/or TBT concentrations in the sediments. We anticipate that our results
(ongoing data analysis) will contribute to a better understanding of the
environmental risk of NPs and their co-contaminants within a relevant scenario.
TH024
Nanopolystyrene Induces a Decrease in the Oxygen Uptake of Zebrafish
Larvae and Enables Sorbed Benzo(a)Pyrene Bioavailability
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Tait, Heriot Watt University; D. Boyle, Plymouth University; M. AL SID
CHEIKH, University of Plymouth / Marine sciences and engineering; T.B. Henry,
Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and
Society
Microplastics (MPs, 5 mm–1 µm) and nanoplastics (NPs, ≤ 1 µm) can result from
larger plastic debris released in the environment and can pose a risk to aquatic
organisms. Potential effects of MPs include disruption of gut physiology after
ingestion, release of substances (co-contaminants) sorbed to MPs into organisms,
and occlusion of tissue surfaces by accumulation of MPs. Although not yet
effectively measured in aquatic environments, NPs may be the most abundant
plastic particles present, but little is known about their effects in organisms.
Because the relative surface area is greater for NP than MPs, there is greater
potential for co-contaminant sorption to NPs and subsequent co-contaminant
release into organisms upon ingestion. We evaluated the bioavailability of the
co-contaminant Benzo(a)Pyrene [B(a)P] sorbed to nanopolystyrene (nPS, 500nm)
by assessing the expression of cytochrome P450 1A (cyp1A) in zebrafish (Dania
reno) larvae (96h postfertilization, hpf). The effects of nPS and nPS with sorbed
B(a)P on larval (96 hpf) metabolic rate were assessed over a 24h exposure. The
concentrations tested for nPS and nPS with sorbed B(a)P were 0-50 μg/ml of
particles, and 0-40 μg/L for B(a)P. Proof of particle ingestion by larvae was
observed using fluorescent nPS (500 nm, μg/ml). Whole-organism metabolic rate
(MR) was assessed by measuring oxygen uptake (MO2), using respirometry
chambers (24 ml) and Pre-Sens optodes. The expression of hypoxia related
molecular biomarkers [cytochrome c oxidase subunit IV isoform 1 (cox4i1),
hypoxia inducible factor 1, alpha b (HIF-αb)] was assessed in the same larvae. Gene
expression was measured by quantitative reverse transcription PCR (RT-qPCR)
after RNA extraction from whole larvae. Sorption of B(a)P to nPS was confirmed
using analytical chemistry techniques [gas chromatography–mass spectrometry
(GC-MS)]. Preliminary dose-response analysis showed that nPS, B(a)P and nPS
with sorbed B(a)P induced a decrease on MO2 by zebrafish larvae, indicating a
higher energetic cost of physiological functions maintenance. The expression of

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cyp1A was up to 9 fold change in the highest concentration of nPS (45 μg/ml) with
sorbed B(a)P, whereas this gene did not expression when larvae were exposed just
to nPS, indicating desorption of B(a)P. We anticipate that our results (ongoing data
analysis) will contribute to a better understanding of the effects and risk of NPs and
their co-contaminants within a more environmental relevant scenario.
TH025
Impacts of exposure to microplastics alone and with adsorbed benzo(a)pyrene
on biomarkers and scope for growth in marine mussels M. galloprovincialis*
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Katsumiti, University of the Basque Country / CBET Research Group, Dept.
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Faculty of Science and Technology and Research Centre for Experimental Marine
Biology and Biotechnology PIE; E. Navarro, University of the Basque country
UPVEHU; M.P. Cajaraville, University of the Basque Country / CBET Research
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and Research Centre for Experimental Marine Biology and Biotechnology PIE
Due to their hydrophobicity and relatively large surface area, microplastics (MPs)
can act as carriers of hydrophobic pollutants in the ocean and may facilitate their
transfer to organisms (so-called “Trojan-horse effect”). This study examined the
effects of exposure to polystyrene MPs of 0.5 and 4.5 µm alone and with sorbed
benzo[a]pyrene (BaP) on mussels Mytilus galloprovincialis in order to elucidate the
effects of MP size and the presence of adsorbed contaminants on the organism. MPs
were provided daily, mixed with algae, at 1000 particles/ml/day, during 7 and 26
days. Effects were determined on early cellular biomarkers (catalase activity
[CAT], neutral red uptake [NR] and DNA damage in hemocytes; histopathology in
digestive gland) and on whole organism responses (scope for growth [SFG] and
condition index). Chemical analysis showed that BaP concentrations in mussels
increased with time (up to 150 times greater than background levels) and that
smaller MPs pose an increased hazard in terms of the transfer of adsorbed BaP. In
histology, large MPs were abundant in the lumen of stomach, mixed with stomach
contents, and in the lumen of digestive tubules (DTs), associated to cell debris.
Occasionally they appeared within epithelial cells of the stomach, ducts and DTs
and in the connective tissue. Small MPs were also abundant in the lumen of
stomach. In all samples, DT appearance indicated a high digestive activity,
confirmed by hexosaminidase histochemistry. Overall, effects in all treatments
increased with exposure time. Increased effects of MPs+BaP compared to MPs
alone were seen in NR and CAT but not in DNA damage despite the genotoxicity of
BaP. An apparent increased effect of smaller MPs on DNA damage was also found.
A general hormetic effect was demonstrated on SFG across MP treatments. This
may be due to a compensatory effect whereby mussels increased their absorption
efficiency in order to increase energy intake to make up for energy used dealing
with stress observed in biomarker responses. This evidenced a link between MP
effects at different levels of biological organisation. Further work is required to
understand the effects of a variety of plastic type, size, shape combinations together
with a wide variety of pollutants.*Funded by Spanish MINECO (NACE project
CTM2016-81130-R), Basque Government (consolidated group IT810-13) and
UPV/EHU (UFI 11/37, VRI grant PLASTOX). Work carried out within EU project
PLASTOX (JPI Oceans 005/2015).
TH026
Characterization of the adsorption/desorption of benzo(a)pyrene to/from
polystyrene micro- and nanoplastics for further toxicity assessment
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Biotechnology PIE; A. Orbea, University of the Basque Country / Dept. Zoology
and Animal Cell Biology and Research Centre for Experimental Marine Biology
and Biotechnology PIE; H. Budzinski, University of Bordeaux
Degradation processes that large plastic items undergo in the sea have led to the
appearance of small plastic pieces known as micro- (MPs) or nanoplastics (NPs),
depending on their size. MPs and NPs can also be specifically manufactured for
industrial and domestic applications, which results in an additional source of
pollution. MPs and NPs become available to biota and enter into the food web.
Moreover, due to their physico-chemical properties, such as large surface to volume
ratio and hydrophobicity, plastics can adsorb/absorb other pollutants present in the
water column acting as Trojan Horses. In order to further investigate the
ecotoxicological aspects of this phenomenon, the characterization of the adsorption
of benzo(a)pyrene (BaP), as a model polyaromatic hydrocarbon, to polystyrene
MPs and NPs (4.5, 0.5 and 0.05 µm), was undertaken. 50 mg.l-1 of plastics of the
three sizes were incubated for 24 h in an orbital shaker at 300 rpm (21°C) in three
BaP solutions (100, 10 and 1 µg.l-1 containing 0.01% DMSO) in MiliQ water. After
the adsorption period, centrifugation was performed in order to settle the plastic and
allow the removal of non adsorbed BaP (NA-B(a)P). NA-BaP was quantified in the

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supernatant by SPME/GC/MS. To measure BaP ad/absorbed to the plastics (A-BaP), plastic solutions were freeze-dried and subjected to microwave-assisted extraction before GC/MS analysis. The ad/absorption capacity of the plastics was calculated in mass of ad/absorbed BaP per gram of plastic (µg g⁻¹). The different sizes of plastic in order to determine the capacity of ad/absorption of polystyrene microbeads and whether this process was directly dependent on plastic size. Results indicated that 0.5 µm daughter MPs had a higher ad/absorption capacity of BaP than 4.5 µm MPs. The percentages of ad/absorbed BaP% from the total BaP solution were 90.88% and 37.18% with a Qₑ of 217.39 µg g⁻¹ and 18.83 µg g⁻¹ (Langmuir model; R²: 0.9862; 0.9477) for 0.5 µm and 4.5 µm MPs, respectively. In both cases the applied methodology was successful to characterise the ad/absorption process of BaP to MPs and is currently being applied to NPs. * Funded by French ANR (NATEX-03-02 and Cluster Excellence COTE (ANR-10-LABX 45), Spanish MINECO (NACE project — CTM2016-8130-R), Basque Government (consolidated research group IT810-13) and UPV/EHU (UFI 11/37 and grant to IMAS).

**TH027**

Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord

a borg, ECOLAB UMR5245 CNRS UPS INPT; C.G. Avio, L. Pittura, S. Gorbi, Department of Life and Environmental Sciences, Politecnico University of Marche, Ancona, Italy; F. Regoli, Università Politecnica delle Marche; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Environmental Sciences; N.B. Hartmann, Technical University of Denmark, Department of Civil and Environmental Engineering; A. van Oyen, Plastic Partner GmbH; T.M. Karlsson, University of Gothenburg; and A. Skjoldal, Norwegian University of Science and Technology.

Extraction and use of plastics has generated millions of tons of plastic waste over the past decades, and the presence of microplastics has been reported throughout the world’s oceans. The ingestion of microplastics in situ has been shown in various species, but important knowledge gaps remain, as most studies focus on pelagic fish species or bivalves used for human consumption. Here, we report the presence of microplastics in ten sediment-dwelling and epibenthic species representative of different feeding modes and trophic levels. The species analyzed include fish, bivalves, echinoderms, crustaceans and polychaetes. Organisms were sampled in the inner Oslofjord (Oslo, Norway), which is a fjord subject to strong anthropogenic pressures. High occurrence of plastic contamination was observed, with microplastic particles found in all species and in half of the individuals on average, and present in 75% of the individuals for some species. The extracted microplastics had various shapes (fibers, fragments, flakes), colors and sizes. Micro-FT-IR analysis revealed the presence of various plastic polymers: polyethylene, polypropylene and polyamide were the most commonly found, with 37%, 25% and 15% respectively. We hypothesize that maritime and fishing activities are the main source of release for these compounds. Indeed, ropes and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polyster, polycryl, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

**TH028**

Development of an optimal analytical protocol for the extraction of persistent organic pollutants adsorbed on plastic debris in the environment


Accumulation of persistent organic pollutants (POPs)-loaded microplastics (MPs) in the aquatic milieu is an emerging issue of international concern. Qualitative/quantitative determination of POPs on MPs is essential for the estimation of the impact of POPs-loaded MPs on a range of marine organisms. In general, hydrophobic pollutants like POPs are first extracted from the matrix, in this case plastic debris, using non-source of release for these compounds. Indeed, ropes and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polyster, polycryl, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

**TH029**

Comparison of spiking and dialysis tubing methods for the determination of sorption capacity and plastic-water partition coefficient of three different polycyclic aromatic hydrocarbons on microplastics


Determination of sorption capacity of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aqueous environment. However, due to high octanol-water partition coefficients (Kow) as well as low water solubility, determination of sorption capacity of POPs on MPs in the laboratory is challenging. Here we present two methods to determine plastic-water partition coefficient of three polycyclic aromatic hydrocarbons (PAHs) on low-density polyethylene (LDPE): conventional spiking method and cellulose dialysis tubing method in batch test in the laboratory. PAHs selected for this test were naphthalene (log Kow = 3.3), phenanthrene (log Kow = 4.46) and fluoranthene (log Kow = 5.16). The plastic samples tested here are LDPE pellets with amount of additives. LDPE pellets were previously characterised by CARAT GmbH (Bocholt, Germany). For the spiking method, batch reactors containing given amount of LDPE and MilliQ water were prepared. A high concentration of single PAHs in ethanol solution was injected into each batch reactor until the PAH concentration became stable. PAH concentration in the batch was controlled using high performance liquid chromatography (HPLC). For the dialysis tubing method, on the other hand, a closed dialysis tubing (permeability of 12,000-14,000 Dalton) containing a given amount of LDPE and MilliQ water was placed in each batch reactor filled with MilliQ water with single PAHs far above solubility. The water concentration outside of the tubing was expected to stay constant (= water solubility) during the entire experiment. The PAH concentration in the dialysis tubing was controlled using HPLC until the PAH concentration became stable. All batch reactors were placed on a horizontal shaker. When the adsorption of PAHs is completed, PAHs on LDPE are to be extracted and quantified using gas chromatography-mass spectrometry (GC/MS). Sorption capacity of each PAH was derived from the experiments and methods were compared. PE-water partition coefficient of these PAHs were derived based on the sorption capacity using adsorption models. TU Darmstadt and CARAT are participants of an EU project „PLASTOX“, a consortium of a JPI Ocean’s Joint Action.

**TH030**

Microplastics in food and beverages - a distorted perspective on risk

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Microplastics are ubiquitous in aquatic environments and they are ingested by a wide range of animals, including species for human consumption, i.e. bivalves and fish. Additionally, plastic particles have been reported in other food products and beverages, like honey, salt, beer and drinking water. This has triggered a discussion on the human health implications of this contamination – an aspect that has gained increasing attention in the scientific and public debate in recent years. The focus and extent of this debate, however, stands in contrast with scientific findings, which merely show the presence of microplastics in certain products but no actual effects on humans. It is without question that plastics can constitute a human health risk but the degree to which microplastic exposure via food products and beverages contributes to this health risk is likely insignificant at present time. When considering the magnitude of plastic usage and consequential exposure to plastic materials in our everyday lives, the relatively few microplastic particles that have been reported in food products and beverages will likely only constitute a minor exposure pathway for plastics and associated chemicals. But as this is rarely put into perspective, the current debate creates a distorted picture of plastic exposure and risks to humans, resulting in a misdirected outrage when people find out about plastic particles in fish, while they at the same time not reflect on the plastic container in which the fish is packaged for transport to stores and homes. In this way, the focus is taken away from the root of the problem, namely our use, disposal and plastic materials. We therefore want to encourage a more balanced and careful discussion on human health implications of plastics that takes these aspects into account.
TH031

Is the Arctic threatened by plastics? Identifying sources and determining the distribution of microplastics around Svalbard

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Where is all the plastic, and what concentration of microplastics are ecosystems being exposed to? These are puzzling questions to the scientific community when comparing estimated values on annual plastic pollution with the actual measurements in the world’s oceanic habitats. Recent investigations find plastic far away from any potential sources, such as in deep ocean sediments and buried within polar sea ice. The Arctic Ocean has, despite its remoteness, been suggested as a sink for plastic. Fed by the thermohaline circulation driven deep-water formation, the Arctic Ocean’s bottom might be a dead end for plastics. However, very few studies have quantified the actual environmental concentrations of plastics in this remote area, thus the exposure to organisms living in this environment and potential effects are unknown. In this study, we investigated the occurrence, potential sources and distribution of microplastics in the Norwegian Arctic. We quantified and characterized anthropogenic particles >10μm in different environmental compartments (sediment, water, benthic invertebrates and sea ice) around the western and northern coasts of Svalbard. Samples were collected close to a sewage outlet and far from human activities close to the sea ice front in the Arctic Ocean. By sampling the Arctic, we are able to detect microplastics associated with different water masses (Atlantic, Arctic and sewage water as well as sea ice) could be quantified. Simultaneous measurements of organic matter tracers for sea ice microalgae (IP25), pelagic microalgae (C25:3) and sewage (coprostanol) enabled correlations to be made on potential sources, pathways and fate of microplastics in the Arctic. Additional analyses of the presence of plastic specific contaminants in sediment and biota facilitated a discussion on potential exposure independent of particle accumulation in the gut. One of the primary objectives of the investigation was to determine the relative importance of local and remote sources for plastic contamination in the Arctic, and preliminary results indicate a clear signal from local sources and sea ice. In order to evaluate the risk posed by microplastics in the Arctic, a study already burdened by multiple stressors, knowledge about sources, fate and concentration of microplastics in different environmental compartments is crucial.

TH032

Microplastics – an ecotoxicological issue? How to balance facts and perception without marginalizing an environmental problem?

C. Völkel, ISOE - Institute for Social-Ecological Research / Water infrastructure and risk analyses; J. Kramm, ISOE - Institute for Social-Ecological Research While plastic has been known as a factor for environmental pollution – symbolized by the plastic bag – for a long time, recent scientific evidence on the massive accumulation in the oceans and the environmental risks associated with microplastics have led to an uprising of the debate. In the 2000s, small plastic particles that had already been detected in seawater in the 1970s were labeled “microplastics” for the first time. Since then, the number of studies on the occurrence and effects of microplastics has risen exponentially. 13 years after the publication of the article by Thompson et al. the question of whether microplastics actually pose a risk to the environment could not yet be answered conclusively. In this study, biotransformation and ecotoxicological effects have so far only been detected at high particle concentrations with limited environmental relevance. Independently of this, the impacts of microplastics are perceived by the general public as a serious threat to the environment and human health. The societal perception and the great mobilization potential proved to be important drivers for risk management. In 2015, the Microbead-Free Waters Act was passed banning microbeads from rinse-off cosmetics in the USA. But how did this happen without an environmental risk being scientifically proven? In the public, the presence of plastic waste is usually equated to the presence of pollution. How do we reconcile this perception with the scientific evidence? The scientific community has not been able to communicate null effect studies. Does this presentation affect public perception? Can we maintain the public interest in this environmental issue without propagating effects that are not there? After all, we agree on one thing: plastics do not belong into the environment. For the presentation, we draw on results of our interdisciplinary research group on plastics in the environment (“PlastX”). Our team comprises researchers from ecotoxicology, chemistry, geology and toxicology analyzing plastics from different environmental as well as societal perspectives.

TH033

Assessing biotransformation and bioconcentration factors (BCF) of fragrance materials using in vitro approaches utilizing rainbow trout liver S9 sub-cellular fractions and cryopreserved hepatocytes

A. Lapczynski, RFID / Environmental Science; K.M. Johannig, KJ Scientific LLC / dba of Pura Vida Connections LLC; A. Jenkins, EAG Laboratories Bioaccumulation potential measured as the bioconcentration factor (BCF) is one of the components for the PBT (persistent, bioaccumulative, toxic) criteria and risk assessments of chemicals by regulatory agencies in some regions of the world (e.g. REACH and ECHA). Biotransformation of chemicals and their derivatives is an important component in the metabolism of environmental contaminants in aquatic systems, and bioaccumulation is influenced by the chemical structure and the presence of biotransformation pathways. In the present study, we investigated the biotransformation and bioaccumulation of fragrance materials in rainbow trout liver S9 fractions and cryopreserved hepatocytes. We used an in vitro approach utilizing rainbow trout liver S9 fractions and cryopreserved hepatocytes to test biotransformation of fragrance materials using in vitro approaches utilizing rainbow trout liver S9 sub-cellular fractions and cryopreserved hepatocytes. The in vitro bioaccumulation assay is a powerful tool that can be used to determine BCF of test chemicals and provide data to build the database information on fragrance materials for fish metabolism and modeling.

TH034

Addressing species diversity in biotransformation: variability in expressed transscripts of hepatic biotransformation enzymes among fishes.


There is increasing evidence that diverse xenobiotic metabolizing enzymes exist among fishes, potentially resulting in different chemical sensitivities and accumulation, but this has never been systematically evaluated. One concern is that model test species such as rainbow trout, zebrafish and fathead minnows may not adequately represent the xenobiotic metabolizing capacity of other fish species. Our current study mined available full-transcript databases and performed a comprehensive full-transcript, isoform sequencing on liver samples from two dozen phylogenetically diverse fish species. This novel RNAseq approach eliminated the need for transcriptome reconstruction resulting in reference genomes of the highest precision, allowing for detection of enzyme isoform orthologues among the species, as well as the nuclear receptors that control expression of the enzymes. Species were selected for broad phylogenetic coverage, as well as economic, research, and conservation importance, and included: sea lamprey (Petromyzon marinus), lake sturgeon (Acipenser floravincens), American eel (Anguilla rostrata), alligator gar (Atractosteus spatula), paddlefish (Polyodon spathula), rainbow trout (Oncorhynchus mykiss), rainbow smelt (Osmerus mordax), fathead minnow (Pimephales promelas), Antarctic icefish ( Trematomus tolembergii), common carp (Cyprinus carpio), and channel catfish (Ictalurus punctatus). In addition to comparing information across fish species, the resolved isoforms were compared to human xenobiotic metabolizing enzymes. This comparison aids in evaluating the utility of human-based biotransformation tools such as ToxCast chemical screening assays or metabolism prediction software for potential relevance in fish. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

TH035

Metabolism of Organophosphate Flame Retardants (OPFRs) in Freshwater Fish: Field and Laboratory Studies

J.L. Currier, U.S. Geological Survey / Center for Environmental Research / Environmental Science, Chinese Academy of Sciences / Key Laboratory of Drinking Water Science and Technology; Z. Wang, Research Center for Environmental Sciences, Chinese Academy of Sciences / State Key Laboratory of Environmental Aquatic Chemistry

Organophosphate flame retardants (PFRs), as widely used alternatives of brominated flame retardants in a wide array of consumer products, pose a threat to aquatic ecosystems. The metabolism of PFRs in wildlife and human. PFRs can be rapidly metabolized in the liver and have been shown to be extensively metabolized in the gut. The general metabolic pathway of PFRs revealed by certain in vitro studies involves dealkylation of the PFRs resulting in their breakdown into dealkylated metabolites. Considering the adverse effects of PFRs, many researchers have paid their attention on the absorption, bioaccumulation, metabolism and internal exposure processes of PFRs in wildlife and humans. PFRs can be rapidly metabolized in the body. The general metabolic pathway of PFRs revealed by certain in vitro studies includes dealkylation, hydroxylation, carboxylation, oxidative dehalogenation and phase II conjugation, resulting in a wide array of metabolites. Dealkylated phosphates (DAPs) from the dealkylation metabolism are often previously shown to be important biomarkers in human biomonitoring studies. As very limited information is available on DAP metabolites in environmental biotic samples, we first investigate
the accumulation and tissue distribution of eight common OP FRs and their four DAP metabolites in three freshwater fish species from locations around Beijing, China. Accumulation of DAPs were relatively lower but comparable to those of PFRs in freshwater fish. DAPs had low limited affinity to lipid content in tissues, similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of PFRs and DAPs than the other tissues of fish. It suggested the existence of parent compounds (PFRs) in wild animal studies. In the consequent laboratory control study, we screened the metabolites of alkyl-PFRs by in vivo exposure of *Gobiocypris rarus*. Metabolites of alkyl-PFRs in fish liver after 30-day exposure were analyzed with UPLC-QTOF/MS in MSE mode. The qualitative results verified the metabolic pathway of dealkylation, hydroxilation, dihydroxylation, desaturation, and phase II glucuronidation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOP, BBOEHEP, and 3-OH-TNDP formed in fish liver microsomes. Liver rather than intestine, plays the primary role in PFR clearance in fish. The significance of these metabolites is in good agreement with human urine monitoring and in vivo rat exposure studies. Overall, the results emphasized the importance of hydroxylated metabolites as biomarkers for alkyl-PFRs exposure.

**TH036 Bioaccumulation and biotransformation of prochloraz in the aquatic invertebrate Hyalella azteca**

D. Fedrizzi, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; A. Rösch, Eawag / Environmental Chemistry; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry

Prochloraz is a widely applied fungicide for pest management purposes. Due to the improvement of new analytical techniques, many of these chemicals, the so-called “emerging pollutants” (EPs), are being currently identified and their occurrence in the environment is being proved in the environment. However, very little is known about the fate of prochloraz in the environment. The aim of this study was to assess the toxicokinetics of prochloraz and its biotransformation products in *Hyalella azteca*. Adults of *Hyalella azteca* were exposed to prochloraz at the concentration of 100 µg L⁻¹ during a 24-hour uptake phase and a subsequent 120-hour depuration phase. Organisms were sampled over time and after extraction, the internal concentration of prochloraz and its BTPs were quantified using reverse phase liquid chromatography coupled to high resolution mass spectrometry with electrospray ionization. Prochloraz and its 30 BTPs were detected, quantified, and respective toxicokinetic profiles were obtained. In every profile, an increase in the internal concentration was seen during the uptake phase followed by a decrease during the depuration phase. The bioaccumulation factor was calculated to be 110 L kg⁻¹. Finally, the data will be modelled to identify the metabolic transformation mechanisms. Different termination and transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in *Hyalella azteca*.

**TH037 Toxicokinetics and metabolite identification of two emerging pollutants, acetamiprid-K and 4-MBC, in the manila clam Ruditapes philippinarum.**

N.C. Ruiz, INMAR - University of Cadiz / Physical Chemistry; F. Toniini, Alma Mater Studiorum - University of Bologna; P. Lara-Martin, University of Cadiz / Physical Chemistry; J. Blasco, Inst. Ciencias Marinas de Andalucia / ECOLOGY AND COASTAL MANAGEMENT; M. Hampel, INMAR - University of Cadiz

Marine ecosystems have been historically sinks for many pollutants and chemicals whose effects awoke social concern, triggering the implementation of legislations. Nowadays, new compounds are developed at increasing rates and eventually discharged into marine ecosystems in unknown quantities and with no regulation. Due to the improvement of new analytical techniques, many of these chemicals, the so-called “emerging pollutants” (EPs), are being currently identified and their occurrence in the environment is being proved in the environment. However, very little is known about the possible adverse effects of these emerging pollutants in exposed non-target organisms. In this context, the present work evaluates the toxicokinetics (TK) of two EPs (the UV filter 4-Methylbenzylidene-camphor (4-MBC) and the artificial sweetener acesulfame K (ACE-K)) in the Manila clam *Ruditapes philippinarum*, focusing on determining the bioconcentration factors (BCF) and identifying metabolites and major degradation pathways. Both the 7 days of exposure and 3 days of depuration, target compounds were extracted from both the water phase and organisms and their concentrations were measured by liquid and gas chromatography coupled to tandem mass spectrometry (UPLC/QC-MS/MS). Additionally high resolution mass spectrometry (HRMS) and automated data analysis software (Metabolynx®) were used to identify possible TPs in the tissue of the Manila clam at different nominal concentrations (from 1 to 100 µg L⁻¹). For the UV filter, the estimated BCF were between 61 553 and 539 133 L kg⁻¹, and several metabolites were identified, such as the reduction or hydroxylation of the compound. On the other hand, the artificial sweetener BCF was consistently lower, around 7 L kg⁻¹ and no metabolites were identified. These results suggest that 4-MBC was highly bioaccumulated and metabolised to facilitate its excretion and they are directly related to the physicochemical properties of the target EPs, since ACE-K is highly soluble in water (log *K*<sub>ow</sub> 1.33) and excreted unchanged in comparison to the very hydrophobic UV filter (log *K*<sub>ow</sub> 5.92). Additionally, the present study provides important information about the toxicokinetics of 4-MBC and ACE-K, which will be helpful for understanding the mechanism of action of these compounds. Furthermore, this work demonstrates the potential of the UPLC-QC/HRMS approach using Metabolynx™ software for fast and accurate identification of metabolites of EPs.

**TH038 Organophosphate Esters, Including Alkyl-Substituted Triphenyl Phosphates, in East Greenland Polar Bears and Ringed Seals: Adipose Tissue Concentrations and In Vitro Depletion and Metabolite Formation**

A. Strobel, Carleton University; W.G. Willmore, Carleton University / Biology department; C. Sonne, R. Dietz, Aarhus University / Department of Biosciences, Arctic Research Centre; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health, Dorval

Due to the improvement of new analytical techniques, many of these chemicals, the so-called “emerging pollutants” (EPs), are being currently identified and their occurrence in the environment is being proved in the environment. However, very little is known about the fate of prochloraz in the environment. The aim of this study was to assess the toxicokinetics of prochloraz and its biotransformation products in *Hyalella azteca*. Adults of *Hyalella azteca* were exposed to prochloraz at the concentration of 100 µg L⁻¹ during a 24-hour uptake phase and a subsequent 120-hour depuration phase. Organisms were sampled over time and after extraction, the internal concentration of prochloraz and its BTPs were quantified using reverse phase liquid chromatography coupled to high resolution mass spectrometry with electrospray ionization. Prochloraz and its 30 BTPs were detected, quantified, and respective toxicokinetic profiles were obtained. In every profile, an increase in the internal concentration was seen during the uptake phase followed by a decrease during the depuration phase. The bioaccumulation factor was calculated to be 110 L kg⁻¹. Finally, the data will be modelled to identify the metabolic transformation mechanisms. Different termination and transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in *Hyalella azteca*.

**TH039 Proteomics of a metabolic simulation system - a look inside rat S9**

A. Schiwy, EWMOSIS; B. Thalmann, RWTH Aachen University, Institute for Environmental Research / Bio5 - ESA; P. Huesgen, Forschungszentrum Jülich GmbH / Central Institute for Engineering, Electronics and Analytics (ZEA); S. Schiwy, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; R.J. Letcher, RWTH Aachen University / Institute for Environmental Research

The liver is the key organ in metabolism and detoxification of xenobiotics. Simulation of this organ in various bioassays is achieved via the application of either single cytochrome P450 enzymes produced via biotechnological processes or complex enzyme mixtures obtained from animals. Especially, this second process is regarded under various animal welfare regulations as an animal experiment. The animals have to be maintained to a specific age and following their livers have to be induced via various chemicals. Furthermore, this treatment may cause pain to the animals. Finally, the animals have to be killed to harvest the organ (predominantly liver) for further downstream processing. The most common procedure is a mincing of the liver and subsequeent species-specific differences. Alkyl-substituted THP analogues also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

**TH040 A critically evaluated database of in vitro and in vivo toxicokinetic data for...**

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A tiered testing strategy for rapid estimation of bioaccumulation by a combined modelling - in vitro testing approach: derivation of kinetic rate constants from three in vitro models

K. Schirmer, Eawag / Environmental Toxicology; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; N. Bramaz, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; N. Bury, University of Suffolk / Division of Diabetes and Nutritional Sciences; M. Embry, ILSI, Eawag / Environmental Health; J. De Salvo Scarporough / Physical and Environmental Sciences; M. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; C. Hogstrand, Kings College London / Division of Diabetes and Nutritional Sciences; C. Kropf, University of Bern / Centre for Fish and Wildlife Health; H. Segner, University of Bern / Centre for Fish and Wildlife Health; R. Schoenenberger, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Studnicka-Michalak, EPFL - Swiss Federal Institute of Technology

Our research seeks to improve alternative methods to estimate bioaccumulation of organic chemicals in fish. We follow a tiered strategy that integrates toxicokinetic (TK) models, quantitative structure-activity relationships (QSARs), in vitro experiments, substrate depletion assays, and rodent studies. We have developed a new database (funded by the JRC CCR.F.C931336.X0) containing TK data (i.e., biotransformation rates) for fish and mammal species (i.e., rat, mice) derived from in vivo and in vitro (59 fraction, hepatocytes, microsomes) methods. The database entries are scored based on a data quality evaluation. The data quality assessment methods and criteria have been developed from standardized testing guidelines when such guidance exists and from professional judgement in the absence of standardized guidance. In total the new database includes approximately 9000 entries for organic chemicals. There are approximately 4000 and 400 chemicals from in vitro and in vivo studies respectively from rodent species. There are approximately 120 and 700 chemicals from in vitro and in vivo studies respectively from fish species. The database can be used as a source of information for chemical assessments and can help identify future research needs (i.e., chemicals that require chemical evaluation and for which reliable quality data are not available). We believe the database will also be a valuable source information for model developers (e.g., for in vitro-in vivo extrapolation models, kinetic models, models to predict exposure and internal concentration in an organism) and chemical evaluators. The database will be publicly available at the Joint Research Centre website.
well as in silico data (e.g., BCF-QSARs) can be included in the QWOE. This presentation provides an overview of the BAT and demonstrates its application with two case studies. The first example is a typical “data poor” scenario in which only chemical structure information is available. From chemical structure relevant physical-chemical property and biотransformation rate data are obtained from QSARs and entered into the system. The second case study is for a relatively data rich chemical (ED) for which LOE exist (e.g., 3 lab BCFS, various BCF-QSARs, biotransformation rate QSARs, in vitro biotransformation rates). Future work for improving the BAT is discussed.

**TH044**
Towards the use of elimination rates in bioaccumulation assessment – Current challenges and future directions

G. Treu, German Environment Agency / REACH Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; C. Rauter, Umweltbundesamt / International Chemicals Management

The capacity of chemicals to bioaccumulate in biota is recognized as critical property that contributes to a chemicals risk. The bioconcentration factor (BCF) reflecting the uptake of a chemical from water and the biomagnification factor (BMF) following dietary uptake in fish remain the preferred metrics in bioaccumulation assessment. The test systems are expensive, time consuming and are not suitable for screening purposes. Still, terrestrial bioaccumulation is hardly considered. A comprehensive bioaccumulation assessment should consider both, the aquatic and terrestrial organisms. Recently, it has been suggested that BCF and BMF can be derived by only determining the elimination rate constant (k_e) experimentally while the uptake rate (k_u) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to k_u is from in vitro experiments while the effect of the other pathways (excretion via urine and feces, and ventilation) are estimated with in vitro to vivo extrapolation models. Biotransformation often reduces the extent to which chemicals accumulate in fish and mammals. Thus, a Tier 1.5 can be introduced between Tier 1 (screening based on physico-chemical data) and Tier 2 (exposure studies with animals) where in vitro biotransformation rates (k_e) obtained from in vitro tests with fish or mammalian cells are extrapolated to whole organisms and then incorporated into to existing chemical mass-balance models to predict a BCF or BMF. Only if this model indicates an increased bioaccumulation a potential a higher-tier vertebrate test is then needed. In practice, animal tests are mandatory for chemicals exceeding a certain level of hydrophobicity but may turn out as non bioaccumulative due to metabolism. A k_u based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro k_of different tissues, e.g. gills, liver and gastrointestinal tract, could be serve as alternative screening criterion under REACH. This model should be experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionics substances, and should be addressed in future research by taking into account specific metabolic pathways. This poster aims at demonstrating current limitations and future needs for the k_u based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

**TH045**
SETAC Bioaccumulation Science Interest Group

L.P. Burkhard, U.S. EPA / ORD/NHEERL/Mid-Continent Ecology Division

Advances in evaluating and regulating endocrine disruptors

**TH046**
Progress of the Japanese Program on Endocrine Disrupting Effects of Chemicals: EXTEND2016

K. Yamazaki, Ministry of the Environment / Environmental Health Ministry of the Environment, Japan published its fourth program on endocrine disrupting effects of chemical substances “EXTEND2016” in June 2016. It is developed upon achievements on development of framework, development and improvement of test protocols and implementation of testing and assessment in the preceding program “EXTEND2010”. While basic concepts and framework was inherited from EXTEND2010, EXTEND2016’s focus has been shifting to implementation of testing and assessment and consideration of appropriate risk management measures. During fiscal years 2016-17 progress has been made in development of test protocols, evaluation of existing knowledge, identification of candidate chemicals for testing, implementation of testing and assessment and communication to the public, as well as in international collaborative projects with the United Kingdom and the United States. One of the most significant achievements should be finalization of the data obtained from the medaka extended one generation reproduction test (MEOGRT) for 4-nonylphenyl, which are expected to be referred to in regulatory environmental risk assessment. The reproduction tests are being conducted for additional chemicals within the program. Updated progress in testing and assessment under EXTEND2016 will be presented at the Annual Meeting.

**TH047**
Effects of endocrine disruptors on reproductive health: A new approach to integrating ecotoxicological and human health data

L. Parent, Télé-université / UER Science et Technologie; P. Grigorova, Université TELUQ / Département Science et Technologie; M. Nikolaros, Université TELUQ / Science et Technologie

Exposure to synthetic and natural chemicals is almost inevitable in our daily lives. Some of them raise concerns with their endocrine disruptive potential and possible interference with endocrine system leading to the variety of adverse health effects. It was initially through clusters of presumptions that the potential effects of endocrine disruptors (EDs) on human health and the environment were highlighted. EDs, as a growing source of concern, now need to better document the complexity of the relationship between exposure and effects, hence the development of new evidence-based approaches to better document decision-making in health policy. Among these approaches, we retained the systematic reviews, based on objective methods, to integrate multiple sources of evidence (epidemiology, wild animals, laboratory animals, in vitro and in silico data) relevant to the evaluation. Our project aims to systematically review the data published the last 10 years linking the existence to EDs (polybrominated diphenyl ethers (PBDE), alkylphenols, bisphenol A (BPA), parabens, phthalates, fluorinated compounds) with the effects on the development and reproductive health as changes in sex ratio, congenital malformations, sperm quality disruption, alteration of plasma levels vitellogenin, sex hormone levels as well as anomalies of gonad development. 16 701 articles were screened and 744 met the inclusion criteria for the review. The data was extracted from 155 elsevier legal frameworks, these fish tests are based on chemical data) and Tier 2 (exposure studies with animals) where in vitro biotransformation rates (k_e) obtained from in vitro tests with fish or mammalian cells are extrapolated to whole organisms and then incorporated into to existing chemical mass-balance models to predict a BCF or BMF. Only if this model indicates an increased bioaccumulation a potential a higher-tier vertebrate test is then needed. In practice, animal tests are mandatory for chemicals exceeding a certain level of hydrophobicity but may turn out as non bioaccumulative due to metabolism. A k_u based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro k_of different tissues, e.g. gills, liver and gastrointestinal tract, could be serve as alternative screening criterion under REACH. This model should be experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionics substances, and should be addressed in future research by taking into account specific metabolic pathways. This poster aims at demonstrating current limitations and future needs for the k_u based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

**TH048**
Pros and cons of fish toxicity tests in detecting chemicals with endocrine disrupting activities

A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods

Unit-EURL ECVM; Z. Dang, RIVM / IJLeC CNRS UMR; S. van der Linden, JRC-EC

In the last decade, with the increased awareness of potential effect of endocrine disruptors (EDs) on wildlife, fish toxicity test guidelines have been developed by adaptive marking studies. Endocrine disrupting substances (EDSS) thus far have been understood as endocrine disrupting activities (EDAs) related endpoints, their robustness (and to which environmental health policy. The first example is a typical “data poor” scenario in which only chemical structure information is available. From chemical structure relevant physical-chemical property and biotransformation rate data are obtained from QSARs and entered into the system. The second case study is for a relatively data rich chemical (ED) for which LOE exist (e.g., 3 lab BCFS, various BCF-QSARs, biotransformation rate QSARs, in vitro biotransformation rates). Future work for improving the BAT is discussed.
tests to screen for endocrine active compounds with multiple publications by both regulatory agencies and academics aimed at identifying appropriate in vitro and in vivo assays. Thus, there has been considerable effort to establish criteria and interpret results for the identification of potential of endocrine active compounds. However, despite all the attention on test development, little consideration has been given to establishing a list of reference compounds to be used in the validation process. Without establishing a set of criteria it may prove problematic to assess interlaboratory variability for the same endocrine mode of action (e.g., estrogenic/androgenic effects). When evaluating the current, validated, assays in OECD Guidance Document 150, there is a great disparity in the reference chemicals selected, and no discussion as to why various chemical were chosen for the validation procedure. Additionally, reference chemical selection is often not consistent with the need for the validation process. This presents challenges to regulators and researchers in selecting assays with needed sensitivity and/or appropriateness of use. Here, we attempt to identify the parameters that should be evaluated when selecting validation chemicals. These range from simple physical/chemical properties, to more complex information related to a known mode of action. Additionally, reference chemicals used during assay validation should span a range of potencies incorporating both positive and negative controls. Some well accepted and commonly used chemicals are provided as a realistic starting point to compile a set list of reference chemicals for the validation of endocrine assays.

TH050
Assessment of endocrine disrupting properties of pesticides and biocides: data processing to support data analysis
A. Lostia, Joint Research Centre - European Commission - Institute for Health and Consumer Protection; S. Munn, European Commission; S. van der Linden, European Commission Joint Research Centre / Directorate F Health, Consumers and Reference Materials; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; E. Grignard, European Commission Joint Research Centre; E. Joossens, European Commission DG Joint Research Centre
In 2016 the Commission completed an impact assessment to estimate possible health, environmental and socio-economic consequences of adopting different options, formulated as scientific criteria, for identifying Endocrine Disruptors (EDs) under the Plant Protection Products Regulation and Biocidal Products Regulation. JRC developed a central element of this assessment, namely, a science-based methodology to screen over 600 chemicals in about 10 months, including all EU-registered biocides and pesticides. The methodology was based solely on already existing data. To achieve the objective of screening hundreds of substances in a limited time, all retrieved data for a substance (toxicological studies, effects observed, NOAEL, etc.) were captured in an excel template (consisting of 40 columns), developed by JRC, in order to systematically organise the information to then facilitate data-analysis. As a result a large and curated database is available summarising relevant existing data collected for the 600 substances screened. A major accomplishment was the development of an innovative way to process and visually represent the data captured in the excel template as a mean to facilitate the data analysis in a systematic manner and in medium-throughput to ensure meeting the objective defined in the Commission Roadmap of screening 600 substances in a limited time and by using high-quality science-based strategy. Briefly the data collected are re-organised and processed into a data-matrix which is built automatically after the template has been filled. The data-matrix, available for each of the 600 substances, is used in getting total local information available for a certain chemical thus facilitating the data analysis to identify EDs. For instance the data-matrix visually reports if certain toxicological endpoint has been observed across different studies to support evaluation of the screened chemicals, allowing getting an overview of all toxicological information at a glance. The data-matrix can be used to group chemicals based on the similarity of their toxicological behaviour as a mean to prioritise chemicals for further analysis or to build read-across strategy to fill data-gaps.

TH051
Assessment of endocrine disrupting properties of pesticides and biocides: data requirements, availability and needs
S. van der Linden, European Commission Joint Research Centre / Directorate F Health, Consumers and Reference Materials; A. Lostia, European Commission Joint Research Centre; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; E. Grignard, European Commission Joint Research Centre; S. Munn, European Commission
Before pesticides and biocides are allowed to enter the European market, a minimum set of toxicological data is required to be submitted in order to evaluate their (unintentional) toxicity and approve their use. In case of concern(s), specific conditions may apply to limit their use or approval might not be granted at all. The data that is required to be submitted is (mostly) coming from standardized test guidelines (TGs). While these TGs focus on a diverse range of toxic effects, none of the TG studies currently in the data requirements are specifically developed for the assessment of endocrine disruption (ED). However, ED specific findings can potentially be extracted from these studies and supplemented with data coming from other sources. OECD Guidance Document 150 can help with the ED specific interpretation of data and a guidance document for assessing pesticides and biocides is currently being developed by EFSA, ECHA and JRC. In the context of the recent ED impact assessment, we screened the regulatory dossiers, scientific literature and other available EDs to assess and categorize all pesticides and biocides currently registered in the EU. This assessment was performed in the context of human and environmental health. This presentation will provide an overview of the results of this categorisation, combined with indications of the origin of the data driving the categorisation: i.e. data obtained from the regulatory dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.

TH052
Plausible or Causal: Bioactivity and mechanistic potency as a critical piece in hazard characterization of endocrine active chemicals
E. M. Mihaich, ER2, K. Plotzke, Dow Chemical Company / Toxicology, Environmental Research & Consulting
While methods have been and are being developed and validated, and regulatory programs around the world are moving forward with evaluating chemicals for their potential interaction with the endocrine system of humans and wildlife, the challenge still remains in distinguishing between effects that are specifically estrogenic/androgenic acting chemicals. Though in vitro screens can be used to predict estrogenic/androgenic effects. When evaluating the recent ED impact assessment, we screened the regulatory dossiers, scientific findings can potentially be extracted from these studies and supplemented with data coming from other sources. OECD Guidance Document 150 can help with the ED specific interpretation of data and a guidance document for assessing pesticides and biocides is currently being developed by EFSA, ECHA and JRC. In the context of the recent ED impact assessment, we screened the regulatory dossiers, scientific literature and other available EDs to assess and categorize all pesticides and biocides currently registered in the EU. This assessment was performed in the context of human and environmental health. This presentation will provide an overview of the results of this categorisation, combined with indications of the origin of the data driving the categorisation: i.e. data obtained from the regulatory dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.
disruptor according to the WHO/IPCS definition.

TH054

Structural Alerts for Potential Endocrine Disruptors

K. Kühne, N. Ost, Helmholtz Centre for Environmental Research UFZ/ Department of Ecological Chemistry; L. A. Baumann, University of Heidelberg/ Analytical Chemistry and Toxicology; H. Seeger, Helmholtz Centre for Environmental Research UFZ/ Department of Ecological Chemistry

Endocrine disrupting chemicals interact with the hormone system. They may trigger adverse effects on organisms. Endocrine disruptors are labelled as substances of very high concern (SVHC) and are subject of regulations as REACH. However, there are so far no internationally harmonised criteria for endocrine activity. Furthermore, the endocrine system is rather diverse. Existing tests are rather expensive, and it is still not clear whether they comprise all relevant pathways. Thus, the number of existing data is limited. Silico tools may provide alternatives at least to allow prioritisation of tests by screening compound lists. This study aimed to identify structural alerts for potential endocrine disruptors of two relevant hormone systems, estrogen/androgen and thyroid hormones. Chemicals binding to the estrogen/androgen receptors may either yield an agonistic effect by mimicking the hormone, or an antagonistic effect by blocking the receptor site and thus preventing the hormones from binding themselves. Thyroid hormones bind to the ligand binding domain (LBD) of the receptor, and secondly binding of a co-activating protein to a part of the LBD (AF-2) triggers gene expression. Chemicals binding to LBD may again yield agonistic or antagonistic effects, for binding to AF-2 only antagonism is known. However, adverse effects to thyroid hormones can also result from other mechanisms as enzyme/protein interaction e.g. with the transporter protein and aryl-hydrocarbon-receptor interaction. Structural alerts to predict chemicals with potential effect on these systems have been developed. For estrogen/xenobiotic receptors systems, previous research has been refined. The model identifies 91% of the active chemicals, and false negative results are weakly active only. The models for LBD and AF-2 binding only miss one active compound. For other thyroid hormone effects a screening level model detects 95% of the known active compounds, but there is suspect of missing compound classes due to the lack of respective experimental data. Particular remarks was given to characterize the applicability domain and reliability of the predictions. All models are implemented as automated tools in the software system ChemProp (UFZ Department of Ecological Chemistry 2017. ChemProp 6.6. http://www.ufz.de/cochem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 3714 63 412 (2).

TH055

Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae

L. Birgersson, J. Sturve, University of Gothenburg/ Department of Biological and Environmental Chemistry; J. Arning, German Environment Agency UBA/ Chemicals; G. Schuurmann, Helmholtz centre for environmental research - UFZ/ Department of Ecological Chemistry

Contaminants of emerging concern in the North American Great Lakes: Assessing species sensitivity using environmental mixtures. S. Kohno, St. Cloud State University/ Aquatic Toxicology Laboratory; N. Cipoletti, St. Cloud State University/ Aquatic Toxicology Laboratory; L. Wang, St. Cloud State University; U. Hasbay, H.L. Schoenfuss, St. Cloud State University/ Aquatic Toxicology Laboratory

In aquatic ecosystems such as the North American Great Lakes watershed, organisms are exposed to complex chemical mixtures throughout life, producing effects not anticipated in laboratory settings designed to test acute effects of single chemicals. By exposing fathead minnows through three generations, we aim to capture exposure effects during sensitive life stages. Through two separate multigenerational studies, we analyzed the effects of both urban and agricultural co-occurring contaminants at environmentally relevant concentrations in the Great Lakes watershed. Fathead minnows were housed in a flow-through exposure system and propagated for three generations (approximately one year of continuous exposure). Larval fish were analyzed for predator avoidance performance, feeding efficiency, and growth. Adult fish were analyzed for fecundity, biological indices, and endocrine characteristics (Vtg, glucose). Both urban and agricultural exposures resulted in growth alterations between treatments most likely due to density-dependent growth. Urban exposure indicated higher fecundity (both first and second generation) at low and environmentally relevant concentrations as compared to control and high treatments, potentially as a therapeutic hazard associated with the estrogenic nature of the mixture. Agricultural exposure indicated a decline in reproduction, and did not evidence any endocrine disrupting effects compared to first generation only, whereas the second generation demonstrated decreases in environmentally relevant concentrations as compared to low and control treated fish, highlighting the differences between adult only exposed fish (first generation) and lifetime exposure (second generation). Urban exposure demonstrated no changes to male plasma VTG (egg-yolk precursor protein), but agricultural exposure demonstrated increases in high exposed male fish (first and second generation) and environmentally relevant exposed male fish (second generation) due to the estrogenic nature of the mixture and exposure during different developmental stages between generations. Results indicate that mixtures, environmentally relevant in composition and concentrations, have the potential to more generally lead to reductions in fecundity, and elevated egg-yolk precursor protein in male fish. Potential, yet unknown, consequences to the population level of exposed aquatic organisms may exist and warrant further study.

TH056

Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae

R. Kühne, N. Ost, Helmholtz Centre for Environmental Research UFZ/ Department of Ecological Chemistry; L. A. Baumann, University of Heidelberg/ Analytical Chemistry and Toxicology; H. Seeger, Helmholtz Centre for Environmental Research UFZ/ Department of Ecological Chemistry

Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures

U. Hasbay, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concern (CEC), including pharmaceuticals, personal care products and industrial agents may impact aquatic life. Previous studies have documented endocrine disrupting hormone effects in fathead minnow larvae exposed to diverse CECs. However, these studies did not consider the complex mixtures of CEC present in the environment. The purpose of the current study was to understand the change on apical endpoints as the complexity of CEC mixtures increases. We tested the hypothesis that as the complexity of CECs in exposures increase, the apical endpoints observed will differentiate from simple exposure endpoints. We assessed the potential of 21 commonly detected CECs on three life stages fathead minnows: embryo (developmental abnormalities, transcriptionsomics), juvenile (survival, escape performance, feeding efficiency, qPCR) and adult (survival, secondary sex characteristics, nest defense, courtship, boldness, qPCR) after 96-hour flow-through exposures. In addition, we began the process of building a series of complex mixtures to study the CEC effects using neural network methodology. Individual compound concentrations and mixture composition was based on an analysis of nearly 500 water samples collected as part of the Great Lakes Restoration Initiative. Our current findings show that the larval survival was significantly reduced (p< 0.05, ANOVA) by diverse CECs including estrone, desvenlafaxine, and tris(2-butoxyethyl) phosphate exposures. Interestingly, exposure to ibuprofen showed a potential therapeutic effect at the medium concentration to assess two divergent treatment technologies of wastewater. We also observed indication of endocrine disruption on our mixture exposure which includes all studied chemicals. We expect that these evaluations will lead us to improve adverse outcome pathway concepts by testing same chemical effects at different life stages of fathead minnows, and forming a linkage between behavioral responses and adverse outcomes.

TH059
Contaminants of emerging concern in the North American Great Lakes: Load reduction and biological recovery after wastewater treatment upgrades

H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; D. Martinovic-Weigelt, University of St. Thomas / Biology; P. Edmiston, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

Many urban aquatic ecosystems are becoming effluent dominated, resulting in the presence of contaminants of emerging concern and subsequent adverse effects on aquatic wildlife. Despite these dramatic alterations, effluent dominated urban systems support many ecosystem services and are used by the nearby human population for recreation. The Metropolitan Water Reclamation District of Greater Chicago upgraded two wastewater treatment plants (one million cubic meters/day each) to disinfection (UV; chlorination/de-chlorination). The receiving aquatic ecosystem adjacent to these two wastewater treatment plants has been the focus of intense biological and chemical study for the past seven years and provides a unique opportunity to assess two divergent treatment technologies of wastewater and their also indicated observation of endocrine disruption on our mixture exposure which includes all studied chemicals. We expect that these evaluations will lead us to improve adverse outcome pathway concepts by testing same chemical effects at different life stages of fathead minnows, and forming a linkage between behavioral responses and adverse outcomes.

TH061
Towards a multiparallel detection of biological effects caused by anthropogenic micro-pollutants

C.E. Reigard, German Federal Institute of Hydrology; L. Moscovici, The Hebrew University of Jerusalem / Institute of Life Sciences, Department of Plant and Environmental Science; G. Reifer, for the detection of a series of biological endpoints: (a) Extraction and pre-concentration of MPs and their possible transformation products in soil or water samples by solid phase extraction. (b) Separation of the extracts using high performance thin layer chromatography (HPTLC). (c) Biological effect measurement of the individual separated constituents by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) bioreporters. A main goal of our study is to develop tools and methods for a multiparallel effect detection covering a range of potentially adverse biological effects. This can be achieved by the construction of yeast strains using specific fluorescence reporters for the various endpoints to be detected. By coupling these strains with HPTLC and mass spectrometry, a wide variety of compounds with biological activity could be screened simultaneously. The first step of coupling HPTLC with mass spectrometry could be a further development of a series of biological endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using various compound references. Furthermore, mixing yeast strains with different endpoints yielded to the detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of an in-house sensor-strains bank for a simultaneous screening of (eco)toxicological effects and (iii) method development for the detection of compounds by chemical analysis after separation by HPTLC. -or clear="all" > [1] A German-Israeli research and development project in the field of water technology within the framework of the BBM-BOST cooperation, FKZ: 02W11387.

TH062
Endocrine disruptors used in polymers in the offshore oil and gas industry

C. Phillips, Cefas Lowestoft Laboratory / Science Directorate - advice and assessment; R. Suering, University of Toronto; A. Smith, Cefas / Ecotoxicology and Molecular Ecology

Compounds were raised by regulatory assessors that a number of polymer substances found in products registered for use and discharged offshore as a result of the activities of the oil and gas industry are based on monomers that are known and suspected endocrine disruptors. These polymers were described by the registration data as being moderately or readily biodegradable substances and might therefore have the potential to biodegrade into the endocrine disruptors on which they were based. It is unclear endocrine disrupting substances or conditions. To determine the potential of these polymers to release endocrine disruptors, four substances with known endocrine disrupting monomer groups were extracted using high pressure and temperature as well as acidification and/or biodegradation and were tested using a Yeast-based estrogen screen (YES) and yeast-based androgen screen (YAS). The results from the presented study show that at least one of the analysed products has a high potential for releasing EDs and highlights the importance of well-informed environmental protection to prevent endocrine disruptors from impacting the marine environment.
Thyroid disruption screening using zebrafish as vertebrate model
J Iturria, O. Jaka, C. Martí, A. Alzuaidi, BioBide; A. Muriana, BBD BioPhenix S.L. / RD

Endocrine disrupting compounds are frequently found in the environment and have a profound impact on the development and physiology of vertebrate organisms. Thyroid Disrupting Compounds (TDC) specifically affects the function of thyroid hormones, interfering with their synthesis, transport and/or binding; altering important physiological processes. Several environmental contaminants such as polybrominated diphenyl ethers or halogenated organophosphates, used as plasticizer and flame retardant, are suspected to produce a thyroid-disrupting effect. Given so, chemical manufacturing entities could benefit from cost-effective methodologies for the screening of TDC in order to deselect candidates during the early phase of the development. In this work, we present an assay for the screening of potential TDC using zebrafish embryo. This vertebrate model is extensively used as a biosensor for the evaluation of acute and developmental toxicity, and several assays in zebrafish are described by the OECD guidelines for the testing of chemicals. Besides, the embryo’s small size and transparency allow to carry out fluorescence-based screening assays with medium throughput. In this work, the thyroid hormone disruption potential of several environmentally relevant contaminant was assessed. For this end, an initial acute toxicity assay was performed in order to estimate the EC50 and NOEC of the tested compounds, and subsequently select concentrations with no systemic toxicity. Afterward, change in the thyroglobulin (TG) synthesis was assessed using a zebrafish transgenic line expressing a reporter gene driven in the liver in line with the 3R principles in relation to TG gene promoter, by analysis of the fluorescence microscopy images. Finally, a gene expression assay, using rt-qPCR, was performed over known markers of thyroid disruption to further characterize the involved pathways of endocrine disrupting effect. The zebrafish assay showed to be a sensitive and cost-effective assay to evaluate the potential thyroid disruptor activity of chemicals.

Development of stably transfected cell lines with zebrafish thyroid hormone receptors alpha and beta for assessing endocrine disruption in environmental samples
V. García Herranz, INIA National Institute for Agricultural and Food Research and Technology, E. Sánchez Martínez, Institute of Aquaculture Torre de la Sal-Spanish National Research Council; M. Fernandez-Cruz, J. Navas, INIA - National Institute for Agricultural and Food Research and Technology / Environment; J. Cerdá Reverter, Institute of Aquaculture Torre de la Sal-Spanish National Research Council

Endocrine-disrupting chemicals (EDCs) are ubiquitous in our environment and can be found in many products including food/feed, containers as plastic bottles or insecticides aimed for insect pest control. Chemicals are being carried out to validate this reporter gene system. More studies on different mammalian cells and competition study with mixtures of chemicals are being carried out to validate this reporter gene system.

Development of stably transfected cell lines with zebrafish thyroid hormone receptors alpha and beta for assessing endocrine disruption in environmental samples
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was different between both exposure routes, while vitellogenin (vtg) and estrogen receptor 1 mRNA levels were similar between both routes after EE2 exposure. At the morphological and physiological level we observed differences as well. However, the degree of ER-binding was similar between both routes from day 1 until day 5. Despite daily refreshment, the EE2 concentration in the medium decreased regardless of the exposure concentration. The internal doses were the highest at the beginning of the exposure for both exposure routes and decreased afterwards. The order of magnitude of the internal dose was also similar between the injection and an aquatic exposure in the µg/L range, which was also seen e.g. for the mRNA expression of vtg. Based on the dose measurements we can conclude that even if the embryos were dosed with EE2 within the same order of magnitude that there were still different outcomes for some endpoints. Therefore micro-injection is rather a complementary method and not an alternative route for aquatic exposure.

TH068
Vitellogenin expression, ovarian growth and hormone levels are affected by atrazine in the crayfish Procambarus clarkii
G. Silveyra, University of Buenos Aires / Dept. of Biodiversity and Experimental Biology, Institute of Biodiversity, Experimental and Applied Biology (IBBEE), CONICET-UBA, P. Silveyra, Penn State College of Medicine / Dept. of Pediatrics; I. Vatnick, Widener University; D.A. Medesani, University of Buenos Aires / Dept. of Biodiversity and Experimental Biology, Institute of Biodiversity, Experimental and Applied Biology (IBBEE), CONICET-UBA, E.M. Rodriguez, University of Buenos Aires / Biodiversity and Experimental Biology.

Atrazine, a widely used herbicide, has been categorized as a suspected endocrine disruptor for many years. Although several studies have investigated the effects of atrazine exposure on reproductive function, its safety remains controversial and the mechanisms of its toxicity remain unclear. In this study, we tested the hypothesis that atrazine can affect reproduction in crayfish through the inhibition of vitellogenin expression and hormone synthesis. Adult female crayfish (Procambarus clarkii) were exposed during one month to atrazine at concentrations of 1 or 5 mg/L. At the end of the exposure, ovaries, hepatopancreas and hemolymph samples were harvested for analysis of vitellogenin expression and steroid hormone levels. Ovarian tissue was also sampled for both biochemical and histological analyses. Atrazine-exposed crayfish had a lower expression of vitellogenin in the ovary and hepatopancreas, as well as smaller oocytes and reduced vitellogenin content in the ovary. Despite these effects, circulating levels of estradiol increased in females exposed to 5 mg/L of atrazine, showing that the inhibiting effect of atrazine on vitellogenin production was not related to a lower secretion of sexual steroids; instead, some early stimulating effects of estradiol on vitellogenesis could have occurred. Moreover, in the hepatopancreas, we could identify two main proteins involved in the endocrine system of amphipods: the milt-inhibiting hormone (MIH) and the ecdysoid receptor (EcR). Next, the expression variations of these two genes have been measured by RT-qPCR in crayfish liver. Together, our data showed that atrazine exposure was able to inhibit vitellogenin production in the crayfish P. clarkii, altering on the other hand the normal balance of sex steroids.

TH069
Identification of milt-inhibiting hormone and ecdysoid receptor sequences in Gammarus pulex and consequences of endocrine disruptor exposures
E. Gismondi, University of Liege
Endocrine disruptors (EDCs) are well known to disrupt the development and the reproduction of exposed organisms. Although this point has been studied in vertebrate models, the limited knowledge of the endocrine system of invertebrates makes the evaluation of EDCs effects difficult. However, invertebrates represent the major part of aquatic ecosystems, such as amphipods, which are crucial for their functioning (e.g. litter degradation, food resource). Moreover, gammarids are hosts of hidden parasites such as vertically transmitted microsporidia (microsporidia VT), which could be confounding factors in assessment of EDC effects, since microsporida VT could feminize juvenile males in some Gammarus sp. Consequently, currently, no biomarkers (assessment tools) are available to address the endocrine disruption in gammarids. The present work focused on EDC effects on the molt process of Gammarus pulex, by researching the DNA sequences of two main proteins in the endocrine system of amphipods: the milt-inhibiting hormone (MIH) and the ecdysoid receptor (EcR). Next, the expression variations of these two genes have been measured by RT-qPCR after an external exposure of four amphipod species (Gammarus pulex, Chironomus riparius, 17α-methyltestosterone (17MT) and the cyproterone acetate (CPA), all commonly studied in vertebrates. Sequence research allowed to obtain a 204 bp length and 255 bp length amplifiers for EcR and MIH, respectively. The EcR sequence encodes for 68 amino acid fragment while the MIH sequence encodes for an 85 amino acid fragment. Exposure of G. pulex males at each EDC highlighted an increased of the MIH mRNA expression and a decrease of the EcR mRNA expression, a trend to increase was observed for the EcR expression only in uninfected gammarids. This work allowed to identify two main proteins involved in the endocrine system of amphipods. Exposure to each EDC highlighted EDCs affecting vertebrates could also impact invertebrates species. In addition, the presence of microsporidia VT appeared to be a confounding factor which could lead to misinterpretation the endocrine risk assessment. Finally, results the premises are promising in the development of PE biomarkers in invertebrates, since this is a tool that is currently missing. However, further studies will be needed to study the variation of these genes and understand their regularization, before to use them as biomarkers.

TH070
Use of in vivo and in vitro assays to investigate the effects and bioavailability of endocrine disrupting compounds in sediment on the benthic invertebrate Chironomus riparius
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Sediments act as a sink and source of chemicals in the environment and, therefore, it is of great importance to know how sediment-bound chemicals affect aquatic organisms. The synthetic hormone 17α-Ethylenestradiol (EE2), a component of oral contraceptives, is ubiquitous in the environment and is a known potent endocrine disrupting compound (EDC) that adversely effects aquatic vertebrates (e.g. reproduction). Developmental effects of potential sediment-bound EE2 on benthic organisms is an important for understanding the potential effects on vertebrate predators and subsequent upper trophic levels as a secondary source of contamination.
Toxic effects of juvenile hormone analogue insecticides, methoprene and fenoxycarb, on cherry shrimp (Neocaridina davidi)

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Crustaceans are a large group of arthropod, and they are the major constituents to aquatic ecosystems that provide a variety of ecological and economic services. Nevertheless, the increasing quantities of insecticides leached into water bodies severely affect the health of aquatic environment globally and heighten the adverse impact on the crustaceans. Among these insecticides, juvenile hormone analogue (JHA) insecticides are a kind of endocrine disrupters known to interfere with the normal hormone action in insects by mimicking the juvenile hormones. However, their structure and functions of the methyl farnesate (MF) in crustaceans are similar to the juvenile hormone (JH) in insects. Therefore, the exogenous JH insecticides would cause adverse effects on the development and reproduction in crustaceans as in insects. The aim of our study is to examine the toxic effects of JH insecticides - methoprene and fenoxycarb on a freshwater shrimp Neocaridina davidi which is successfully cultured and maintained in our laboratory as a new crustacean model. These insecticides are growing in use in agriculture both locally and globally, and their impact to the aquatic ecosystem is needed to be further clarified. In the present study, the acute and chronic toxicity effects of two juvenile hormone analogue insecticides, fenoxycarb and methoprene, on newborn N. davidi were investigated. The 24h and 48h median lethal concentrations (LC₅₀) of fenoxycarb and methoprene were 1.40, 0.97 mg/L (4.64, 3.20 μmol/L) and 1.96, 1.26 mg/L (6.32, 4.06 μmol/L) respectively. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

TH073 Development of Multimedia Fate Model for Human Risk Assessment of EDCs in the Asan Lake Watershed, Korea

M. Choi, J. Kim, Greenecos Inc.; Y. Kim, Greenecos Inc.; CEO

Multimedia fate models (multimedia fate model for H/man Risk Assessment in Multimedia Environment) has been developed considering topographic features and environmental and been meteorological data of watershed region of Asan Lake in Korea. Human risk assessment system using this multimedia fate model was established and integrated to assess spatial exposure and risk about human living in this area. For this purpose, first, GIS database system constructing was performed. The meteorological data and mensural data of these two chemicals have adverse effects on the development of juvenile N. davidi. After six weeks chronic exposure to 100 mg/L (0.33 μmol/L) fenoxycarb and 200 μg/L (0.64 μmol/L) methoprene, the body length decreased by 20.5% and 11.8% as compared to control, respectively. And the total number of molts of 20 shrimp over this period reduced by 29.2% and 17.7%. Differential expressions of JH signaling pathway genes were investigated in this study. The genes h3 (hormone receptor 3) and c75 in N. davidi were up-regulated, while Chd64 (calponinlike protein), CHH (crustacean hyperglycemic hormone), e74, JHE (JH esterase), JHEH (JH epoxide hydrolase) and JHAMT (JH acid methyltransferase) were down-regulated in shrimp treated with fenoxycarb and methoprene. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

TH075 Dietary and non-dietary prenatal exposure to endocrine disruptors (BPA and DEHP). Spanish case study.

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Endocrine disruptors (EDs) are chemicals that send confusing messages to the body, causing various disruptions to developing organisms. Endocrine disruption of the human body is a growing concern, and several EDs have been identified as potential endocrine disruptors. In this study, we investigated the dietary and non-dietary exposure of pregnant women in Spain to two of the most commonly encountered EDs: bisphenol A (BPA) and di(2-ethylhexyl) phthalate (DEHP). The results show that both dietary and non-dietary exposure were significantly higher than the exposure levels reported in previous studies. This suggests that exposure to EDs may be more widespread than previously thought, and that pregnant women are at increased risk of adverse health effects. The findings in this study highlight the need for further research to better understand the mechanisms by which EDs affect the human body and to develop strategies for reducing exposure to these chemicals.

TH076 Sensitive Biomarker Assay using LC-MS/MS: Determination of Thyroid Hormones (T3 and T4) in Fetus, Pup and Adult Rat Serum - Sampling Considerations

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The thyroid hormones, T3 (triiodothyronine) and T4 (thyroxine), play crucial roles in regulating metabolism, growth, and development. Assaying these hormones in biological samples is important for understanding thyroid function and diagnosing thyroid disorders. However, the low concentrations of these hormones in plasma require sensitive and specific analytical methods. In this study, a sensitive and specific LC-MS/MS assay was developed for the simultaneous determination of T3 and T4 in serum. The assay was validated for linearity, precision, accuracy, and limits of quantification (LOQ) of 0.05 pg/mL for T3 and 0.50 pg/mL for T4. The assay was used to analyze serum samples from different rat models, including pregnant females, fetuses, and adult rats. The results indicate that the assay provides accurate and reliable quantification of T3 and T4 in serum, with low LOQs and good precision and accuracy. This assay can be used for studying thyroid function in different biological contexts, including the identification of adverse effects of thyroid dysfunction and the assessment of the impact of environmental exposures on thyroid health.
ensure meaningful data can be collected. An experiment was performed to evaluate if tubes containing clot activator could produce ‘cleaner’ serum samples to avoid loss of data points from analytical instrument signal suppression, yet provide true and accurate data without significant loss of T3 and T4 arising from potential absorption or non-specific binding to the clot activator tube. The CV (precision) and RE (accuracy) for both T3 and T4, across quality control samples (generated from collection tubes (a) and (b)) were within acceptance criteria of ≤20% (25% for the LLOQ) demonstrating that tubes containing clot activator can be used for T3 and T4 sampling.

TH077
Steroid estrogens and estrogen activity were abundant in dairy farm watersheds regardless of effluent management practices
L.A. Tremblay, Cathwron Institute; J.B. Gadd, NIWA / Department of Chemistry; G. Northcott, Northcott Research Consultants Limited
Steroid estrogens contamination has been linked to adverse effects on aquatic biota. Steroid estrogens are excreted by all mammals and are therefore found in most agricultural wastes including dairy manure and dairy shed effluent (DSE). Some previous studies have demonstrated elevated levels of free and conjugated estrogenic steroids in DSE and this source has increased as New Zealand has experienced rapid expansion and intensification of dairy farming. This research used an approach incorporating analytical chemistry and bioassays to evaluate the levels of estrogenic activity in environmental samples from representative dairy watersheds with differing DSE management practices: either livestock effluent discharged into waterways or as a degrade of the main dairy cow effluent, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalents, Eeq) was found at low levels in 83% of the stream samples (highest: 1.44 ng L⁻¹ Eeq) and the group activity ranged from 0.15 ng L⁻¹ Eeq). While estrogenic activity was generally ~1. one of (10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L⁻¹, a level potentially harmful to aquatic biota. Comparable steroid estrogen concentrations and estrogenic activity were found whether DSE was spray irrigated on farm paddocks or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

TH078
Toxic receipt: Why You Should Avoid it?
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Bisphenol A (BPA) is at the moment one of most commercial chemicals at global scale and is used in production of thermal papers as a color developer. BPA is not chemically bound to paper, so in contact with skin, it migrates into the skin, and is absorbed. This chemical is proved to be toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. Estrone was the predominant steroid measured in watershed waters because of its presence in dairy cow wastes and as a degrade of the main dairy cow effluent, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalents, Eeq) was found at low levels in 83% of the stream samples (highest: 1.44 ng L⁻¹ Eeq) and the group activity ranged from 0.15 ng L⁻¹ Eeq). While estrogenic activity was generally ~1, one of (10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L⁻¹, a level potentially harmful to aquatic biota. Comparable steroid estrogen concentrations and estrogenic activity were found whether DSE was spray irrigated on farm paddocks or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science (P)

TH080
Evaluate the ecological risk during product development: safe by design case study - Met@link project
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Safe-by-design requires risk evaluation at critical points during the development of a product to enable a well documented choice for the lowest risk option. In the Met@link project new metal-based inks - enriched with Ag-nanoparticles (Ag-NP) - for printing conductive tags are developed. The environmental risk is assessed to support decisions between different environmental risk options (or risk management options). Environmental Risk Assessment (ERA) allows assessment of the potential effects on the one hand (concentration effect relations for the target organisms) and evaluates the potential exposure of target organisms on the other hand (i.e. to define the environmental compartments and organisms of concern). Risk management either reduces the potential effects (i.e. redesigning the product) or prevents the predicted exposure (i.e. redesign the production process) to minimize the potential risk. Case study: ERA Ag-NP metal based ink. Potential environmental concern?

Literature data learn that Ag-NP particles are indeed highly toxic to aquatic ecosystems, mainly due to the leaching of Ag+ ions. Potential exposure? Looking at the production process the aquatic ecosystem is of concern because of the waste water generated during production of the inks. Two prototype inks with suitable technical properties were formulated. Both were tested for their leaching potential and for their ecotoxicity to aquatic organisms. Ag-concentrations (ICP-AES) and Ag-NP (SP-ICP-MS) were measured, and the ecotoxic effects on algae (OECD 201) and Daphnia (OECD 202) were measured. Results showed that proper coating material helped to prevent leaching of Ag+ and substantially decreased the ecotoxicity of the leaching fraction.

TH081
REACH Substance Evaluation of silver - justification of read-across from ionic silver to nanosilver
K. Ariis, ARCHE; J. Mertens, Precious Metals and Rheinum Consortium c/o EPMF
As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify the read-across from ionic silver to silver nanoparticle. Literature data learn that at the moment one of most commercial chemicals at global scale and is used in production of thermal papers as a color developer. BPA is not chemically bound to paper, so in contact with skin, it migrates into the skin, and is absorbed. This chemical is proved to be toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. Estrone was the predominant steroid measured in watershed waters because of its presence in dairy cow wastes and as a degrade of the main dairy cow effluent, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalents, Eeq) was found at low levels in 83% of the stream samples (highest: 1.44 ng L⁻¹ Eeq) and the group activity ranged from 0.15 ng L⁻¹ Eeq). While estrogenic activity was generally ~1, one of (10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L⁻¹, a level potentially harmful to aquatic biota. Comparable steroid estrogen concentrations and estrogenic activity were found whether DSE was spray irrigated on farm paddocks or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify the read-across from ionic silver to silver nanoparticle. Literature data learn that: "The behaviour of nanoparticles is at the moment one of most commercial chemicals at global scale and is used in production of thermal papers as a color developer. BPA is not chemically bound to paper, so in contact with skin, it migrates into the skin, and is absorbed. This chemical is proved to be toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. Estrone was the predominant steroid measured in watershed waters because of its presence in dairy cow wastes and as a degrade of the main dairy cow effluent, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalents, Eeq) was found at low levels in 83% of the stream samples (highest: 1.44 ng L⁻¹ Eeq) and the group activity ranged from 0.15 ng L⁻¹ Eeq). While estrogenic activity was generally ~1, one of (10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L⁻¹, a level potentially harmful to aquatic biota. Comparable steroid estrogen concentrations and estrogenic activity were found whether DSE was spray irrigated on farm paddocks or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

TH082
Revising REACH technical guidance on information requirements and chemical safety assessment for engineered nanomaterials for aquatic ecotoxicity endpoints - recommendations from the EnvNano project
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The European Chemical Agency (ECHA) is in the process of revising its guidance on aquatic ecotoxicity of the smallest silver nanoform with the highest specific surface area registered under REACH as compared to ionic silver. The tested nanoform shall be sufficiently characterised; Information on the fate of nanosilver in soil only in case any of the ecotoxicity tests show higher toxicity for nanosilver as compared to ionic silver; Information on the uses for each individual nanof orm registered under REACH. An ecotoxicity testing programme was therefore undertaken comparing the effects of nanosilver with silver nitrate using 3 internationally standardised and accepted aquatic ecotoxicity tests: Toxicity to the alga Pseudokirchneriella subcapitata (OECD Test Guideline No. 201); nanosilver was less toxic than silver nitrate. Long-term toxicity to Daphnia magna (OECD Test Guideline No. 221); nanosilver was less toxic than silver nitrate. Toxicity to soil microorganisms (OECD Test Guideline No. 216) in 3 soils representative for the EU: nanosilver was equally or less toxic than silver nitrate. The silver nanof orm was fully characterised (aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape, mean primary particle size 9.4 nm). The dissolution behaviour of the tested silver nanoform was determined in the test method used in the ecotoxicity tests. The nanosilver dissolution behaviour qualitatively explained the observed toxicity. Since the ecotoxicity testing demonstrated that nanosilver was equally or less toxic than ionic silver, further fate testing in soil was not required. The data collection on the uses of the silver nanof orms covered by the REACH registration dossier showed limited tonnage and use of nanosilver. Furthermore, since nanosilver is transformed to ‘bulk’ silver during its use, there is limited release to the environment. The generated data show that the read-across of toxicity values from ionic silver to nanosilver as a ‘worst case’ approach is justified and scientifically defensible.
in suspension is fundamentally different from that of chemicals in solution. The aim of this paper is to present the findings of the EnvNano project and through these provide the scientific background for specific recommendations on how ECHA guidance could be further improved. Key EnvNano findings such as the need to characterize dispersion and dissolution rates in stock and test media have partially been addressed in the updated guidance. However, it has to be made clear that multiple characterization methods have to be applied to describe state of dispersion and dissolution over time and for various test concentrations. More detailed information is called for on the specific characterization methods and techniques available and their pros and cons. Based on findings in EnvNano, we recommend that existing algal tests are supplemented with tests where suspensions of nanomaterials are aged for 1-3 days for nanomaterials that dissolve in testing media. Likewise, for downstream tests we suggest to supplement with tests where a) exposure is shortened to a 3h pulse exposure in daphnia toxicity tests with environmentally hazardous metal and metal oxide nanomaterials prone to dissolution; and b) food abundance is three to five times higher than normal, respectively. We further suggest that the importance of considering the impact of shading in algal tests is made more detailed in the guidance and that it is specified that determination of uptake depth depends on the guidelines for each commercialized functionalization of the nanomaterials is required. Finally, as an outcome of the project a method for assessing the regulatory adequacy of ecotoxicological studies of nanomaterials is proposed.

TH083 Identifying criteria for environmental risk assessment models at different stage-gates of nano-material/product innovation considering requirements of various stakeholders
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The EU H2020 project calibrate aims to establish a state-of-the-art versatile risk governance framework for assessment and management of human and environmental risks of manufactured nanoparticles (MN) and MN-enabled products/applications, incorporating ecotoxicological innovation parameters of these materials and products. Initial efforts have focused on identifying criteria for environmental risk assessment (ERA) models and tools for such governance framework. It was recognized that some criteria are applicable to both environmental and human risk assessment (HRA), and these so-called “overall” criteria were identified through joint efforts of the ERA and HRA working group experts in caLIBRaTE. The identified “overall” criteria relate to RA model features and resources needed to use the tools, whereas the criteria specific to ERA models relate to model outcome on hazard, exposure and risks. The identified criteria were listed against the Cooper stage-gates®, thus forming a table in which the importance or relevance of each criterion could be assessed for each of the stage-gates. This was formed into questionnaires with defined response options for each stage-gate (e.g. environmental transformation and ecotoxicological effect) and the importance of the criterion. These questionnaires were sent to stakeholders representing regulators, consultants, researchers and industries, who provided their feedback, either by filling the questionnaires or by listing general input on their current RA approaches or needs. Efforts to obtain input from NGOs and insurers remain ongoing. The feedback clearly illustrated different requirements between stakeholder groups. For example, not all use the (same) stage-gate approach or have the same level of expertise for RA. Other criteria were similar or significantly important to most stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria suggested useful for users in caLIBRaTE partners included the use of multiple characterizations and safety-by-design considerations as low cost options to identify “red flags” for hazard and/or exposure at early stage-gates of MN innovation. The criteria and stakeholder feedback generated will be applied to evaluate existing models/tools against, but also to enable the creation of a “System of systems” for RA along stage-gates when developing MN and MN-enabled products, incorporating the needs of different specific user groups.

TH084 Considerations of nanomaterial’s environmental fate to support grouping and environmental risk prediction
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Engineered nanomaterials (ENM) are used in different products with the consequence that they can be released into the environment during their life cycle. Given the large varieties of ENM, the effort for an individual investigation and assessment would be enormous. Therefore grouping of ENM and read across between different materials is a major target for future risk assessment. In this poster we present practicable approaches that can support the discussion on grouping of ENM regarding their environmental potential and function in our project. This is focused on the behaviour of the pristine ENM in aquatic and terrestrial compartments. The transformation (chemical transformation and dissolution) and the transport (mobility and agglomeration) of an ENM in the environment was studied. To predict the exposure potential for the environmental compartments both pieces of information were combined to result in a number code (factor of low to 3 for high) for a so called “fate bond” which will be included in a matrix of ENM grouped regarding their potential environmental risk. For example, if the transformation via dissolution and chemical transformation is low in the environmental compartment, the transformation potential of the ENM is low. If the mobility is low and the agglomeration potential is high, the transport is also low. Low transformation and low transport means high ENM exposure potential in the considered compartment and leads to a number value of “3” in the fate bond. For simplification, in this project water phase and sediment phase are considered as one compartment (water compartment) and therefore transport and mobility affected by e.g. agglomeration and sedimentation are not needed to be considered in the presented approach. In contrast, for soil systems the mobility was analysed in detail, as important factor for the exposure concentration. For an environmental risk assessment the fate information is called “overall” hazard properties (ecotox bond; present at an additional post) of an ENM. In this poster, the concept to support discussion on grouping and risk prediction will be presented and discussed by using various ENMs as examples. Keywords: transformation, transport, fate grouping Acknowledgement - The results are generated in the framework of the project nanoGRAVUR which is funded by the German Federal Ministry for Education and Research (BMBF) under grant no.: 03XP0002

TH085 Matrix to predict possible environmental risk of nanomaterials during use
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Given the increasing number of engineered nanomaterials (ENMs) is a strategy in environmental risk assessment that should allow an adequate hazard assessment while reducing the testing effort needed for a material-by-material fate and effects testing. We present a practicable matrix that allows to group of ENMs regarding their potential risk to the aquatic and terrestrial environment. This matrix are based on the combination of assumptions regarding release and fate as well as ecotoxicological effect. The analysis the fate information is based on the following two matrixes on the production volume of the ENM, that portion which is relevant for the considered use, use in closed / open systems, and slow / fast release into the environment. The resulting so called “release bond” classes ENMs to ENMs with low release (release bond = 1) to high release (release bond = 3). The release grouping is followed by a detailed description of release scenarios for the considered use. These scenarios allow the identification and aggregation of the ENMs, which can be removed from the ENM is emitted. Furthermore, possible sinks become obvious for which the fate and ecotoxicological effect grouping need to be performed. Basically, surface water, sediment and soil are possible sinks in the environment. To simplify the fate grouping approach, surface water plus sediment are here supposed to be a monophase system. Thus, chemical transformation and dissolution are considered as relevant processes for the aquatic fate grouping. Transformation (chemical and dissolution) and transport (agglomeration and movement) are considered relevant processes for the terrestrial fate grouping. The so called “fate bond” classes ENMs to ENMs with low exposure potential (fate bond = 1) to high exposure potential (fate bond = 3). In a next step, release bond and fate bond are combined to a so called “overall bond” (5 groups in total) and subsequently combined with the so called ecotox bond. The latter one is based on information about ecotoxicity of the bulk material, morphological formation of ENM, and the ion release potential. The combination results in a 5 x 5 matrix with 25 possible combinations of exposure and ecotox bonds. These are summarized to three risk groups low, medium and high. The applicability of the approach will be demonstrated by risk grouping of nano-ZrO₃ and nano-TiO₂ used in sunscreen products. Key words: release, fate, ecotox bond

TH086 Concepts for nanomaterial categories regarding environmental hazard and for prediction of their environmental risk as well as proof of principle
K. Hund-Rinke, Fraunhofer IEM / Department of Ecotoxicology; D. Kuehnel, UFZ / Helmholtz Centre for Environmental Research; C. Nickel, Institute of Energy and Environmental Technology e.V. - IUTA / Air Quality & Sustainable Nanotechnology; K. Schwirn, German Federal Environment Agency UBA; D. Volker, German Environment Agency; E. van der Zalm, German Federal
Environmental Agency UBA

The grouping of engineered nanomaterials (ENMs) is being intensively discussed in order to develop approaches that allow an adequate hazard assessment of ENMs while reducing the testing effort or to rank them regarding their environmental hazard. Two approaches differing in their focus have been developed and evaluated with a set of 25 ENMs. Based on systematic testing using aquatic test designs used in regulatory testing, the physical-chemical (PC) properties, i.e. morphology and particle size, as well as ecotoxic properties of ENMs were identified as relevant parameters. The zeta-potential was considered to be less important. Regarding the parameters ecotoxicity of the bulk chemical, solubility and reactivity we decided upon a pragmatic approach with questions which have to be answered “yes” or “no”. Approach I (ecotox flow-chart) is characterized by maximum 24 questions. For the property morpholgy is defined by three categories i.e. fibers, small spherical ENMs, others. The ecotoxicity of the ENMs of a specific group is attributed to similar PC-properties thus support discussion on grouping with the final objective of read across. Approach II (ecotox-bond) was developed for risk assessment by using an approach similar to control banding. For risk assessment the hazard information has to be combined with properties influencing environmental fate. For the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotox-bond every “yes” for an answer gives one point. The points are added together resulting in five groups in a range of 1 to 5 which is used for further assessment. The same number of points can be achieved by different properties resulting in groups of ENMs which can differ significantly in their PC-properties. This procedure is considered suitable for the initial prediction of risks as it is more important that it has been subjected the environmental fate. Both approaches are considered to be a suitable starting point for further discussions and developments. Besides the definition of threshold values for solubility, fiber morphology and size of small spherical ENMs, further parameters (e.g. attachment of ENMs to algae) have to be explored to improve the consistency of the groups. Regarding the terrestrial ecotoxicity, soil properties seem to reduce the impact of the toxic properties of the ENMs. Currently the prediction of terrestrial toxicity is not satisfactory.

TH087
Forms of released engineered nanomaterials: A systematic assessment in material flow analysis
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The forms in which engineered nanomaterials (ENMs) are released to the environment affect their fate and toxicity, two parameters essential to risk assessment. Yet, most of current models assessing ENM releases to the environment do not fully account for the transformations that they undergo before release to the environment. This work consists in the development of a method based on current literature, expert elicitation and probabilistic material flow analysis (PMFA) for modelling the proportions of nano-Ag and nano-TiO₂ flowing in different forms and pathways (e.g. material transformations), matrix-embedded (ENM released while embedded in a solid matrix), nanoparticulate (non-transformed, not embedded ENM including free, aggregated and agglomerated ENMs) and product-embedded (ENM contained within a whole product, going to solid waste treatment) forms to the environment. Transformations of ENMs in the environment are excluded from the scope of this work. The method simulates 10 transformation routes between four compartments. The ENMs flow from production, manufacturing and use to wastewater treatment (sewer system, wastewater treatment plant and sludge) and solid waste treatment (landfilling, incineration and recycling) before reaching air, soil or surface water. Each mass flow was described with a probability distribution. The variability of the data obtained in the literature was used to assess the width of these distributions. Nano-Ag is released to surface water and soil mainly in transformed forms (61% and 77%, respectively), while nanoparticulate forms dominate the releases to air (60%). Most transformations occur in water. Nano-TiO₂ presents contrasting results, as most of the releases to air, soil and water are in nanoparticulate forms (80%; 94% and 99%, respectively). The only transformation identified occurring in air is transformation from solid to gas forms in which ENMs are released constitutes an essential piece of information for the input data to environmental fate modelling. For the first time, a method was developed for a systematic assessment of these released ENM forms. Results show that, especially for nano-Ag, the actual nanoparticulate form represents only a small fraction of the total ENM mass released to the environment, thereby calling for a revision of current exposure levels commonly used.

TH088
Using the SimpleBox4nano tool for predicting the environmental concentration of nanomaterials
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In environmental risk assessment the risk quotient, predicted environmental concentration (PEC) relative to the predicted no effect concentration (PNEC), is a useful indicator for risk of chemicals. The SimpleBox⁴ modelling approach has long been applied in the regulatory framework REACH, as part of EUSES, to calculate PECs. The SimpleBox model was recently extended for use with nanomaterials (SimpleBox4.0-nano), by updating particle specific transport process algorithms and including nanomaterial specific transformation processes, such as agglomeration and dissolution. In this study we show the sensitivity of SimpleBox4.0-nano to the newly added process parameters. This shows that in addition to the dissolution rate of an ENM, agglomeration efficiency and the concentration of natural particles and their size play a role. In order to use SimpleBox4.0-nano we provide guidance on measuring or calculating the relevant input parameters. Furthermore, we indicate the relevance of the different fractions of PECs as calculated by SimpleBox4-nano for estimating the risk quotient. 1: www.rivm.nl/simplebox4: 2: Meesters, I.A.I., et al., Multimedia Modeling of Engineered Nanoparticles with SimpleBox4-nano: Model Definition and Evaluation. Environmental Science & Technology, 2014. 48(10): p. 5726-5736.

TH089
Directions of in silico method development to complement the predictive models used in risk assessment of nanomaterials
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There is an increasing need for predictive risk assessment of nanomaterials (NMs) to support regulations that are currently under development. The ENMs flow from production, manufacturing and use to wastewater treatment (sewer system, wastewater treatment plant and sludge) and solid waste treatment (landfilling, incineration and recycling) before reaching air, soil or surface water. Each mass flow was described with a probability distribution. The variability of the data obtained in the literature was used to assess the width of these distributions. Nano-Ag is released to surface water and soil mainly in transformed forms (61% and 77%, respectively), while nanoparticulate forms dominate the releases to air (60%). Most transformations occur in water. Nano-TiO₂ presents contrasting results, as most of the releases to air, soil and water are in nanoparticulate forms (80%; 94% and 99%, respectively). The only transformation identified occurring in air is transformation from solid to gas forms in which ENMs are released constitutes an essential piece of information for the input data to environmental fate modelling. For the first time, a method was developed for a systematic assessment of these released ENM forms. Results show that, especially for nano-Ag, the actual nanoparticulate form represents only a small fraction of the total ENM mass released to the environment, thereby calling for a revision of current exposure levels commonly used.

TH090
NanoScreen - Minimizing the risk associated with nanomaterials used in sunscreen at all lifecycle stages
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Among cosmetics and personal care products, sunscreen products are of emerging concern regarding both environmental and human healths. While some organic UV blockers have been evidenced to undergo rapid photodegradation, to induce allergenic skin reactions due to dermal penetration, or to cause deleterious effects on marine system, the fate of mineral UV blockers is still under consideration from a regulatory perspective. This is largely related to the potential impact of nanotechnology-based products on both environment and human health. The nano-TiO₂ and UV-blockers typically used in sunscreen usually consist of rutile nanoparticles coated with a first mineral layer of silica or alumina aiming at blocking the photocatalytic character, and thus passivating the nanomaterial. In addition, the grafting of a second layer of organic coating is aimed at favoring the nanomaterial dispersion in the cream formulation. Once drained from the skin either through bathing activity or everyday usage and cleaning, the nanomaterials contained in the sunscreen can be released to the sea shore. Their behavior in this system is largely determined by this industrial coating and by their initial dispersion in the formulation. This project aims to develop the Eco-design of sunscreens through the implementation of both life cycle and eco-efficiency. First step in the development of sunscreens, we developed tools to simulate the environmental impact of sunscreens and associated with nanomaterials incorporated into the formulation. The fabrication and end of life steps are mainly considered and studied using the following two approaches. In order to estimate the release of nanomaterials from sunscreen in marine environment and the subsequent bioaccumibility to the living organism, we carried a field campaign on three beaches on the french coast. The titanium concentration was measured in the sea water as a function of the time of presence of swimmers. It is fair to say that the higher concentration in the sunscreen, the higher the release factor. In order to decrease the nanoparticles concentration in the sunscreen without decreasing the sun protection factor, the filter selection and coating property is a key step. The filter coating determines its dispersion in the cream formulation, and thus the UV ray protection on the skin. In a laboratory approach we aimed to formulate the best filter-cream dispersion, in order to maximise the sun protection factor while maintaining low dose of nanoparticles.
A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel *Corbicula fluminea*.


The identification and scientific assessment of compounds that bioaccumulate in organisms and biomagnify in food webs play a key role within the PBT-assessment. The bioaccumulation potential of compounds is commonly expressed in form of bioconcentration factors (BCF) determined in flow-through studies with fish according to OECD 305. Comparable studies with manufactured nanomaterials (MNMs) are difficult to carry out due to the lack of suitable test systems that allow a permanent and constant exposure of the compounds. MNMs tend to sediment in water and are supposed to be primarily taken up by benthic species in aquatic ecosystems. Different studies have shown that mussels are able to ingest and incorporate MNMs suspended in water. However, existing standardised test methods to investigate the bioaccumulation of substances in mussels have been developed and optimized for soluble, non-particulate substances. Therefore, an alternative test concept was developed allowing to investigate the bioaccumulation of MNMs in mussels without flow-through conditions. First studies were carried out with the freshwater mussel *Corbicula fluminea*. Using silver MNMs (NM300K) and silver nitrate we were able to compare the accumulation and elimination of ionic and nanoparticulate silver. Mussels were exposed for a period of 4 - 6 days. In both cases steady state concentrations of total silver in the mussel tissue were reached within 24 hours. The quantification of the bioaccumulated silver in water and mussel was performed by ICP-MS or ICP-OES. The bioaccumulation and dissolution rates were used to determine bioaccumulation factors for both test items. In a further study the bioaccumulation of a titanium dioxide nanomaterial (NM 105) was tested. The studies have shown that the new test system is suitable to investigate the bioaccumulation of MNMs.
The global distribution of certain perfluoroalkyl and polyfluoroalkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible endocrine effects. There is a vast array of PFASs adsorbed on the film forming aminosulfonic acid (AFF) impacted sites may be contaminated by the relatively limited number of certified standards to ensure a rigorous quantification. A possible solution is the implementation of a surrogate approach such as the total oxidizable precursor (TOP) assay, relying on the oxidative conversion of potential perfluoroalkyl acid precursors (Pre-PFAs) into readily measurable perfluorocarboxylates. However, in order to ensure a fully legitimate comparison between conventional (i.e. before oxidation) and after TOP analyses, a number of critical knowledge gaps remain to be bridged. The two types of water samples (i.e. before TOP versus after TOP) might reveal differential instrument matrix effects or necessitate different clean-up strategies, which could de facto impact the method reporting limits and preclude a consistent comparison between the two approaches. The present work aimed at assessing the applicability of the TOP assay to various water matrices through stringent validation. The performance of a workflow involving persulfate oxidation followed by ultrahigh performance liquid chromatography tandem mass spectrometry (TOP-UHPLC-MS/MS) analysis was therefore evaluated using various environmental waters. The validation endpoints ascertained included, notably, the evaluation of oxidation yields in the various matrices assayed. TOP assay was a critical assessment of the matrix effect that may occur at the instrumental analysis stage. The method was applied to a limited survey of surface water and groundwater samples. It was observed that even though fluoroalkyl sulfonates (2FTSAs) were the target pre-PFAs predominantly reported before oxidation in most instances, they could only partially account for the observed AFFFAs (molar concentration increases upon oxidation). The unexplained AFFFAs portion likely results from the oxidation of untargeted pre-PFAs for which oxidation yields are yet to be determined.

TH096
Use of biochar for the sorption of poly- and perfluorinated alkyl substances (PFAS) and heavy metals from contaminated soils

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The contamination of soil with a mixture of compounds represents a worldwide environmental issue. Contaminants in soil can leach to groundwater or be transferred to the food chain by crop uptake and affect safety and quality of food resources. Of particular concern is industrially contaminated soils, where high concentrations of both organic and inorganic pollutants can be found. In the present study four soils with different types of pollution (poly- and perfluorinated alkyl substances (PFAS) and heavy metals) and two different total organic carbon contents (high and low), were used. PFASs are a class of compound characterised by hydrophobic, alkylated, fluorine-saturated carbon chain with a hydrophilic head attached at a terminal end. PFASs have a binding preference towards the hydrophobic parts of the humic fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.

TH098
Environmental degradation rates for new PFAS via decarboxylation potential in water, in a MS-collision cell and silica gel

V. Nikolai, NILU – Norwegian Institute for Air Research

Straight-chain perfluorourilphatic carbonylic acids, like PFOA, are extremely stable chemical compounds. In contrast, several other perfluorinated carbonylic acids are less stable and undergo decarboxylation - spontaneous degradation with loss of carbon dioxide. For instance, perfluorobenzoic acid decomposes slowly in aqueous solution, while perfluoropropionic acid and CO2 so fast at room temperature that its spontaneous decomposition is a synthetic method for nonfluorosubstrate. There are indications that novel oxygen-containing analogs of PFOA are less stable towards decarboxylation. A typical detection method for PCFAs is based on the same decarboxylation process: SRM transition from [M−1] to [M−45]. A collision energy, required for such transition is a measure of intrinsic stability of a compound. Therefore, relative collision energy of this transformation can be satisfactorily predicted by DFT calculations at standard RB3LYP/6-31+G(d,p) level. Decarboxylation rates in water for perfluorinated and structurally similar carbonylic acids also correlate well with MS and DFT-derived energies. Thus mass-spectral information and results of simple quantum-chemical modeling can be used as a measure of abiotic degradation potential for per- or perfluorinated acids in aquatic environment.

TH099
Perfluoralkylated acids (PFAs) in soil and invertebrates (Isopoda) near a fluorochromat plant in Flanders, Belgium

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Perfluoralkylated acids (PFAs) have been produced for over five decades. Due to their hydrophobic and lipophilic character they are suitable for a wide range of applications. However, PFAs may enter the environment, accumulate in wildlife and may cause detrimental effects. The widespread use of PFAs has resulted in a global presence. Therefore the major global manufacturer, 3M, phased out the production of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in 2002. Nevertheless, these compounds are still detected in high concentrations in the environment and biota. Especially the fluorochromat plant has been characterized as PFAs hot spot for environmental contamination. In the present study we measured the concentration of 12 PFAs (8 perfluoralkyl carboxylic acids (PFCA) and 4 perfluoralkyl sulfonic acids (PFSA) in soil and isopods collected at a fluorochromat plant in Antwerp, Belgium. In addition, samples from four other areas were collected, representing a gradient in distance from the pollution source. We tested for both correlations between soil properties (e.g. total organic carbong (SOC)) and PFAs concentrations in soil, as well as correlations between PFAs concentrations in soil and invertebrates. In the soil, PFBA, PFOA and PFOA were the only compounds that were detected at all sites. Soil concentrations of all other compounds, with exception of PFOA and PFBS, were < LOQ in all sites except for the plant site. Median concentrations of 606 ng/g ww for PFOS and 8 ng/g ww for PFOA were detected in soil at the plant site, which are high compared to what has been reported in previous studies conducted in the area. Furthermore, these concentrations decreased significantly with distance from the plant. However, concentrations did not differ between the three locations that were situated farthest away from the plant. No significant differences in TOC were
observed among the studied sites, but TOC was positively correlated with multiple PFASs, including PFOS and PFOA. At this moment (November 2017), isopods have not been tested for PFASs concentrations yet, but based on the soil concentrations and concentrations detected in previous studies near the fluorochlorinated plant in Antwerp, we expect high concentrations of multiple PFASs. The outcome of the present study will be used in further monitoring studies on the effects of soil type on PFASs bioavailability to invertebrates, as well as effects of PFASs on multiple biomarkers.

**TH100 Occurrence and distribution of legacy per- and polyfluoralkyl substances (PFASs) and fluorinated alternatives in coastal waters of the German North and Baltic Seas**

H. Joerrs, Helmholtz-Zentrum Geesthacht / Chemistry and Environmental Chemistry

In an attempt to close this gap in knowledge, we performed a suspect screening for (ultra-)short chain PFASs of several substance classes in environmental water samples, waste water treatment plants and building materials.

**TH102 Utilization of passive samplers to detect per- and polyfluoralkyl substances (PFASs) in wastewater treatment and environmental water samples**

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Poly- and perfluoralkyl substances (PFASs) are of growing concern worldwide, due to the linkage of these compounds to adverse effects in humans and the environment. Surface waters in the northeastern United States in particular have displayed elevated concentrations of PFASs. Here we utilize passive samplers to gain a better understanding of the sources and spread of these contaminants. Thirty-two microporous polyethylene (PE) passive samplers (containing Hydrophilic-Lipophilic-Balanced sorbent) were deployed across nine sites in Narragansett Bay (RI, USA) in the fall of 2017 for a one month duration each. Deployment sites ranged from wastewater treatment plant and industrial outfall, to drinking water and fire training fields. Presence of PFASs in the environment is caused by discharges of wastewater effluents or river flows, urban runoff, atmospheric deposition of volatile precursors and subsequent transformation, or direct application of fire-fighting foams containing PFASs, among others. Samples were collected in two semiconfined coastal areas, one of them an area with high industrial and port activities (Ria de Vigo) and the other one with high touristic and recreational activity (Mar Menor). PFOA, PFOS, PFDA, n-MeFOSA, n-EFOsA were extracted from sediments by sonication, cleaned up by dispersive solid phase extraction and the analyzed by LC-MS/HRMS in full mode (Concha-Graña, et al. 2017). This is the first time that these compounds were measured in these areas. N-MeFOSA and N-EFOsA were not detected in any sample, whereas PFOSA was only detected in two samples, but below the quantification limit. PFOS was measured in 39 % of samples, most of them from Mar Menor. In Ria de Vigo PFOS was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than quantitation limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 µg/L. In Ria de Vigo PFOS was measured at level higher than quantitation limit. PFOS was measured in 39 % of samples, most of them from Mar Menor. In Ria de Vigo PFOS was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than quantitation limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 µg/L. In Ria de Vigo PFOS was measured at level higher than quantitation limit. PFOS was measured in 39 % of samples, most of them from Mar Menor. In Ria de Vigo PFOS was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than quantitation limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 µg/L. In Ria de Vigo PFOS was measured at level higher than quantitation limit. PFOS was measured in 39 % of samples, most of them from Mar Menor. In Ria de Vigo PFOS was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than quantitation limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 µg/L. In Ria de Vigo PFOS was measured at level higher than quantitation limit. PFOS was measured in 39 % of samples, most of them from Mar Menor. In Ria de Vigo PFOS was detected in a point close to a ceramic factory.
Fluorotelomer alcohols (FTOHs) and other poly- and per-fluorinated alkyl substances (PFASs) are common and ubiquitous by-products of various industrial telemerization processes. They can degrade into various perfluorinated carboxylic acids (PFACs) including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), which are persistent organic contaminants of concern. This study assessed the use of polyethylene passive samplers as a sampling tool for volatile PFAS precursors coupled to their analysis via gas chromatography-mass-spectrometry (GC/MS). Parallel active and passive sampling was also performed in ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 pg/m³), with traces of other volatile PFASs also present. Polyethylene-air partitioning constants, log kₚₑₑ, were determined for 60 FTOHs and a Waste Water Treatment Plant (WWTP) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log kₑₑ, during the 3-week uptake experiments. Derived log kₑₑ values for 6,2, 8,2 and 10,2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSE and EiFOSE, derived log kₑₑ values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MeFOSE and EiFOSE.

TH105
Occurrence and Removal of perfluoralkyl and perfluoropolyether substances (PFASs) in full-scale water and wastewater treatment plants
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Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) and their metabolites have been detected in biota within CHMI bioaccumulation monitoring program (Republic. Monitoring comprises two profile sets containing 21 and 22 monitoring stations, such as perfluorinated sulfonic acids (PFSAs) and perfluorinated carboxylic acids (PFACs), are ubiquitous contaminants in the aquatic environment, including wildlife and humans. Perfluoralkyl acids bind to proteins and the binding in bioaccumulation behaviour differ from that of lipophilic substances. Therefore, conventional methods (fish fillet analysis, lipid normalization, etc.) to monitor their concentrations in aquatic biota cannot be used as such to assess the bioaccumulation and biomagnification of PFCA and PFSA. In this study, conventional monitoring approaches and new strategies are compared to assess the best methodology to be implemented in biota monitoring plans for these contaminants. Several fish species (Cyprinidae and other freshwater fish species) from deep lakes were seasonally collected for the analysis of 10 perfluorocarboxylates, 7 perfluorosulfonates and 5 perfluorosulfonamides. Individual fish were measured, weighed and dissected in three fractions: whole viscera, the muscle and the rest of the carcass (head, fishbone, skin and fins). The fractions of six fish were analysed separately or pooled in one or two samples for the subsequent analysis. The dry weight, the lipid and the protein content were measured in each fish fraction (muscle, viscera and the rest of carcass). PFAS analysis were carried out with fresh samples but some samples of fillet were also freeze-dried in order to compare the concentrations. Extraction of the animal tissues (2-5 g) was performed by sonication with ACN/H₂O mixture enhanced by salting out and acidification; extracts were analyzed by LC–HRMS to determine the concentrations while the fillet concentrations were from 4 to 8 fold lower than the concentrations of the other two fractions of the fish. Fish fillet analyses proved to be a significant decrease in pre- and PFOS, PFDoDA and PFTrDA were the dominant PFAA’s in the food web of an urban site in Ceske Budejovice / South Bohemia in Ceske Budejovice / South Bohemia. This study assessed the potential contribution of targeted and unknown fluoroalkyl compounds to the apparent biomagnification of perfluoroalkyl acids (PFAA) in the food web of an urban site in the Czech Republic. Ten lipids were characterized by gas chromatography followed by HRMS: fish blood 105, fish liver 15, fish muscle 78, Corresponding author: V. Kodra, E-mail: kodra@fzu.cz

TH106
Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers
V. Kodra, D. Leonovtsyova, Czech Hydrometeorological Institute / Section of water quality; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrobiocosms Objective of the Study The study compares PFOS and PFOA concentrations detected in biota within CHMI bioaccumulation monitoring program from years 2010 – 2016. Material and Methods A bioaccumulation monitoring of selected perfluorinated compounds was performed in five freshwater lakes in the Czech Republic. Monitoring comprises two profile sets containing 21 and 22 monitoring sites. Sampling at those two site sets alternates in the three-year cycles. Sites are located at important parts of main Czech rivers (country borders, before confluences, downstream industrial sites or large cities, etc.). An assessment was made for following matrices: juvenile fish, benthos (Hydropsychidae, Ephemeroptera, Plecoptera and Trichoptera) and organo-fluorines to the apparent biomagnification of perfluoroalkyl acids (PFAA) in the food web of the urban river Orge (near Paris, France). A total of 16 PFAs and 10 of their potential precursors (pre-PFAs) including 4 perfluorooctane sulfonamide derivatives, 4 fluorotelomer sulfonates (FTSAs) and 2 polyfluoralkyl phosphates (diPAPs) were analyzed in water, sediments and biota samples including invertebrate and fish species. PFASs were ubiquitous in all compartments and 22 mixed-effect models were detected. Fish Fillet analysis were performed on 140 ng.g⁻¹ wet weight and PFOS, PFDoDA and PFTrDA were the dominant compounds. Pre-PFAs as 6,2, 8,2 and 10,2 FTSAs as well as FOSA, N-MeFOSA, N-EtFOSA and 6,2 diPAP were also frequently detected (60–100 %) and the sum of these compounds contributed to 1–18 % of ∑PFAS. Trophic magnification factors (TMFs) were estimated using a generalized linear mixed-effect model and were > 1 for C₁₂-C₁₆ PFCAs and C₁₀-C₁₄ PFAs, as well as several pre-PFAs such as 8,2 and 10,2 FTSAs, FOSA, N-MeFOSA, N-EtFOSA and 6,2 diPAP. However, a significant decrease in pre-PFCAs/PFCAs concentrations with trophic level suggested a possible contribution of
precurors to the apparent biomagnification of PFCAAs, via their biotransformation. In addition, the Total Oxidable Precursor (TOP) assay was applied to sediments and, for the first time, to biota samples. Results revealed the presence of large proportions of unknown pre-PFAs in sediments/biofilm/leaf litter samples (64-80 % of total PFAS molar concentration); this proportion was lower in invertebrates (28-54 %) and in fish (15-26 %). These results suggest either the biotransformation of precursors in benthic invertebrates and fish or the limited bioaccessibility of unidentified sediment-bound pre-PFAs.

TH109
PFAS and their precursors in the Environment. First indications from a large scale environmental monitoring study
Per- and Polyfluorinated Substances (PFAS) have been an ongoing challenge for the environmental sciences for decades. However, the substance versatility, in terms of chemical classes and physico-chemical characteristics yet hinders a full overview of the spectrum. Due to the differential mobility and degradation pathways, the environmental distribution of individual species is complex and requires massive analytical effort. This obscure situation is even stretched by new molecules from international markets, that already travel around the world as inorganic salts or as ingredients of rainbow trout feed. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFSA), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFDA), and also precursors (e.g. PAP, dFAP, FTS, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH110
A physiologically based toxicokinetic (PBTK) model describing the bioaccumulation of two perfluorinated substances in rainbow trout (Onchorynchus mykiss)
A. Vidal, Irstea Lyon; R. Beaudoin, INERIS / Models for Ecotoxicology and Toxicology METO; E. Vulliet, CNRS / TRACES Team; E. Rochard, Irstea Bordeaux / UR EABX; J. Garric, Irstea Lyon / UR RIVELERY / Laboratoire Ecotoxicologie; M. Sjödin, J. Lindberg, E. Vincent, Swedish Toxicology Science Research Center / Toxicokinetics with slow uptake before hatching compared to a typical bioaccumulation behaviour has been observed. Absorption, metabolisation, distribution and elimination (ADME) are considered in order to substract or as injection of rainbow trout precursors. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFSA), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFDA), and also precursors (e.g. PAPs, dFAPs, FTS, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH111
Does water temperature influence the toxicokinetics of perfluorinated substances? Comparison of two dietary experiences in rainbow trout
Per- and Polyfluorinated Substances (PFAS) have been an ongoing challenge for the environmental sciences for decades. However, the substance versatility, in terms of chemical classes and physico-chemical characteristics yet hinders a full overview of the spectrum. Due to the differential mobility and degradation pathways, the environmental distribution of individual species is complex and requires massive analytical effort. This obscure situation is even stretched by new molecules from international markets, that already travel around the world as inorganic salts or as ingredients of rainbow trout feed. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFSA), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFDA), and also precursors (e.g. PAP, dFAP, FTS, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH112
Toxicokinetics of perfluorinated alkyl acids in zebrafish embryo
C. Vos, Karolinska Institutet; G. Johanson, Karolinska Institutet / Institute of Environmental Medicine; M. Näslund, S. Wulff, Karolinska Institutet / Institute of Environmental Medicine IMM; M. Sjödin, M. Hellstrandh, J. Lindberg, E. Vincent, Swedish Toxicology Science Research Center / Toxicokinetics of perfluorinated alkyl acids (PFAS) are widely distributed and have been detected e.g. in humans, wildlife and numerous other environmental matrices. These surfactants are highly bioaccumulative as well as persistent and have been associated with several health effects including hepatotoxicity, immunotoxicity and developmental toxicity. The chemical structure of PFASs mainly differ in two ways: the length of the hydrophobic alkyl chain and the hydrophilic end groups. Little or nothing is known how the structure affects the toxicokinetics (TK) (uptake, distribution, biotransformation, elimination) and, consequently, the toxic effects in different organisms. We therefore studied the TK of four PFASs; perfluoroctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS) and perfluorobutanoic acid (PFBa) in the great crested goby fish (Dano rerio). The results indicate biphasic uptake kinetics with slow uptake before hatching compared to a typical bioaccumulation behaviour has been observed. Absorption, metabolisation, distribution and elimination (ADME) are considered in order to substract or as injection of rainbow trout precursors. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFSA), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFDA), and also precursors (e.g. PAPs, dFAPs, FTS, NaDONA) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH113
Role of bioaccumulation in the derivation of environmental risk limits for two perfluorinated substances, PFOA and HFPO-DA
E. Verbruggen, RIVM Institute for Safety of Substances and Products; E. Smit, RIVM / Centre for Safety of Substances and Products; P. Wassenaar, National Institute for Public Health and the Environment (RIVM)
Environmental risk limits (ERLs) were derived in the Netherlands for the substances perfluorooctanoic acid (PFOA) and hexafluoropropylene oxide dimer acid (HFPO-DA); also referred to as GenX, FRD-902 or PFOSnew. These ERLs serve as advisory values according to the guidance under the Water Framework Directive to set environmental quality standards (EQS) in Dutch policy. For these two PFAS substances, the assessment of the bioaccumulation potential is a key issue in the derivation of the ERLs. The most critical receptors are humans and wildlife, which are not only exposed directly via drinking water, but also obtain a significant part of the total exposure indirectly through their diets. For this purpose, bioaccumulation through the (aquatic and terrestrial) food chains has to be evaluated. This information is amply available for PFOA, but is very scarce for HFPO-DA. For PFOA, a typical bioaccumulation behaviour has been observed.
The bioaccumulation factors in the aquatic environment appeared to be dependent on the exposure concentration. For both the terrestrial and aquatic food chain, the specific protein-binding behaviour of PFOA requires different methods for normalisation of the concentration values, than those normally applied to hydrophobic substances, i.e. based on lipid and organic carbon. Not only exposure via food, but also the human toxicological threshold value of PFOA itself is determined by the protein-binding. Higher sensitivity and bioavailability need better be accounted for in the difference in toxicokinetic half-life between human and laboratory animals, like rats and mice. For HFPO-DA kinetic data are only limited, which hampers the derivation of a human-toxicological threshold. It is further investigated based on the available data for both substances whether these findings for PFOA can be extrapolated to HFPO-DA, taking into account the structural differences between both compounds. Additional experimental bioaccumulation data for HFPO-DA is probably needed to complete the ERL derivation.

TH114 Perfluoroether carboxylic acids - are these substances appropriate PFOA-Alternatives regarding their environmental concerns? C. Stuhlsat, G. Seethaler, A. Biegel-Engler, German Environment Agency - UBA / Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; L. Vierke, German Environment Agency / Chemicals Perfluorooctanoic acid (PFOA) is a persistent, bioaccumulative and toxic substance. To minimize the exposure of humans and environment a restriction according to REACH will come into force in the EU in 2020. For a global restriction, the UN善s treaty on持久性有机污染物 (POPs) under the Stockholm Convention. As a result of the regulatory activities as well as voluntary measures, PFOA has been replaced with other fluorinated as well as non-fluorinated alternatives. The use of PFOA as processing aid in fluoropolymer production has been mainly substituted with perfluoroether carboxylic acids (PPECA). PPECA are structurally similar to perfluorooalkyl carboxylic acids such as PFOA. Due to the absence of a perfluoralkyl chain, PPECA are much less persistent in the environment. Therefore, the German Environment Agency has assessed the environmental hazards in the context of substance evaluations under REACH for certain PPECA such as ADONA (ammonium 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-hexafluoro-3-trifluoromethoxypropanyl) and GenX (ammonium 2,3,3,3-trifluoro-2-(heptafluoropropoxy)propanoate). The poster will present a summary of the substance evaluations. PPECA are expected to be very persistent under environmental conditions. The substances have a low bioaccumulation potential in aqueous organisms. However, just as weakly persistent, PPECA may not fit into the common accumulation pattern. Furthermore, the substances are probably mobile in the aquatic environment and can reach the groundwater and consequently drinking water resources. PPECA have already been detected in surface water, groundwater and drinking water around fluoropolymer production plants [1-4]. In conclusion, further data are necessary, but the available information on PPECA already demonstrates that these substances are hazardous for the environment and further risk management measures are needed. [1] Gebbink WA, van Asseldonk L, van Leeuwen SPJ, 2017. Environ. Sci. Technol. Lett. 4, 507-510 [2] Sun M, Arevalo E, Strynar M, Lindstrom A, Richardson M, Kearns B, Pickett A, Smith C, Knappe DRU. 2016. Environ. Sci. Technol. Lett. 3: 215-219 [3] Schreiber J. 2014. Untersuchung des Transportverhaltens von ADONA in Boden und Grundwasser anhand von Feld- und Laborstudien. Diploma thesis [4] Heydebreck F, Tang J, Xie Z, Ebinghaus R. 2015. Environ. Sci. Technol. 49: 8386-8395 [9]: 14742-14743

Fluoropolymers, therefore, are distinctly different from the other polymeric and non-polymeric classes of PFAS and should be separated from all other classes of PFAS for hazard assessment or regulatory actions. Grouping all classes of polymeric and non-polymeric PFAS together for restriction or regulation is not scientifically appropriate. Fluoropolymers, as polymers of low concern, are uniquely benign PFAS.

TH116 Fluoropolymers Are Unique, Low Hazard PFAS Needing Different Analytical and Regulatory Approaches Than Monomeric Fluorinated Substances of High Health and Environmental Hazard B. Henry, T. Kennedy, W.L. Gere & Associates, Inc; H. Fiedler, Oerbro University, Oerbro, Sweden Fluoropolymers, such as polytetrafluoroethylene (PTFE), differ from other monomeric and polymeric per- or polyfluoroalkyl substance (PFAS) classes, such as perfluorooalkyl acids, or polymeric precursors that degrade to them. Fluoropolymers do not demonstrate the same toxicity or physical/chemical/thermal properties as other PFAS. Fluoropolymers, such as PTFE do not meet the criteria of PMT (Persistent) or Bioaccumulative Toxic (B), or they are not very Persistent and/or very Bioaccumulative (PM or PMT) substances criteria proposed by the German Environmental Agency, Umwelt Bundesamt (UBA, 2017). As high molecular weight fluoropolymers (e.g., PTFE) are benignly persistent (i.e., not mobile, bioaccumulative or toxic), all “highly fluorinated” substances do not pose equivalent health or environmental hazards and thus should not be regulated as a single class of chemicals. Chemical analytical techniques useful for differentiating one fluorinated substance from another are readily available, reliable, and reproducible and should be employed to identify and quantify those highly hazardous monomeric per- and poly-fluorooalkyl substances (PFAS) individually, rather than techniques aggregating all fluorine containing substances into one group (e.g. total organic halogen, and total organic fluorine). Therefore, high molecular weight fluoropolymers, as a uniquely benign class of polymeric PFAS, require analytical and regulatory approaches differentiating them from fluorine-containing substances that present high health and environmental hazards.

Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (P)

TH117 Challenges and Open Questions in Earthworm field testing T. Vollmer, Europsin Agroscience Services EcoChern GmbH / Field Ecotoxicology; O. Klein, Eurinosin Agroscience Services Ecotox GmbH / Ecotox Field; S. Knaebe, EAS Ecotox GmbH / Ecotox Field In the risk assessment of plant protection products for in-soil organisms, the earthworm field test following ISO 11268-3 (ISO 2014) is used as the highest tier option. The test protocol is currently under revision and transition to an OECD document under the auspices of UBA (Germany), mainly focusing on improving/testing statistical and bioassay design (e.g. effect of replication) and exploring the options to run the test in a dose-response design. In the light of the recently published EFSA opinion on soil risk assessment (EFSA, 2017), and with roughly 20 years of experience with the field test under the ISO guideline, other aspects of the test also might require revision, namely: Description of field site requirements (size and position of initial earthworm population), e.g. minimum requirements, potentially derived from typical MDD values for a given endpoint, Land-use of the field site (arable fields vs. permanent grassland): is there a preferred option, and/or does this depend on characteristics of the substance under test? Site management/maintenance in general (soil cultivation, crop rotation vs. minimum disturbance) and more specifically in the case of testing a substance with herbicidal action (impact on vegetation coverage in test-item treated plots vs. plots of positive and negative control). Plot size and distance between neighbouring plots, plot allocation patterns, and plot separation, especially with a view on potential migration of earthworms between plots and on external re-colonization. Testing of persistent substances (e.g. how to establish a plateau concentration in soil)? Toxic reference (positive control): reduced replication for the toxic reference? Alternatives to the standard reference item Carbendazim? Examples and suggestions will be given and discussed in this contribution and areas for further research will be identified. EFSA ([European Food Safety Authority], 2017: Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms. EFSA Panel on Plant Protection Products and their Residues (PPR). EFSA-Q-2011-00978, Parma, Italy. ISO, 2014: ISO Guideline 11268-3: Soil quality – effects of pollutants on earthworms. Guidance on the determination of effects in field situations.

TH118 Regional Differences of the Environmental Risk Assessment of Pesticides in Soil with a special Focus on the European Union I. Hamonou, National School of Engineering of Sfax, Tunisia / Laboratory of Water, Energy and Environment; J. Sousa, University of Coimbra / Department of Life Sciences; J. Roembke, ECT Oekotoxikologie GmbH
In the European Union (EU) the environmental risk of chemicals is regulated in various ways. Probably the most complex approach in place is the one for pesticides, mainly because these chemicals differ from other chemical groups by three reasons: (1) They are intended to harm organisms, i.e. those which are impacting agriculture. However, many of the pest species affected by pesticides belong to the same taxonomic groups being responsible for many soil functions and services. (2) They are also directly distributed in the environment, usually by spreading pesticides in various other ways such as a coating on seed material. (3) Since their effects are supposed to act only against the pests, when being applied regularly the amount of pesticides ending up in the environment is high. Due to the long experience with this very detailed approach the results of the EU ERA for pesticides are often taken over by other countries (e.g. in Africa). But is this procedure reliable? This contribution focuses on the soil compartment and tries to tackle the following questions: (1) Can (and if yes: how) regional differences (e.g. regarding ecological or agricultural factors) influence the performance or the outcome of pesticide ERA? (2) How do ecological and agricultural differences influence the pesticide ERA within the European Union? Our findings show that regional differences in abiotic, biotic and anthropogenic factors can affect the fate of pesticides in soil as well their effects on soil organisms, meaning that these differences should be considered in pesticide ERA. Proposals will be made how to improve the ERA process but keep it at the same time practical (e.g. by using a tiered approach). These ideas will include the selection of representative reference soils and test conditions for Mediterranean regions. In addition, we will discuss whether the range of standard test species used so far is sufficient. In this context comparisons such used for regulation. This data of soils are statistically evaluate helpful. Based on the answers to these questions it will be discussed whether (and if yes, how), the ERA of pesticides has to be modified for Mediterranean regions (both inside and outside of the European Union).

TH119 Adaptation of the earthworm field test method: conceptual overview and first results

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In 2016, the German Federal Environment Agency (UBA) launched a project entitled “Necessary adaptations of the standard Earthworm Field Test” to improve the scientific basis when transferring the ISO 11268-3 (1999) guideline to a new OECD standard. As a first step, a literature search was performed to compile available data from earthworm field tests, both from the open literature and from anonymous studies used for regulation. This data of soils was statistically evaluated to develop a design for a pilot study for the earthworm field test. In February 2017, a workshop was held to discuss the outcome of this statistical evaluation and in particular the proposal for a pilot field study test design together with members of the “OECD-GSIG-Earthworm Field Group”. During and after the workshop, the group agreed on a test design including various aspects of statistical robustness, practicality and flexibility. In these discussions various options were checked, all of them with the intention to improve the quality of the output but without increasing the efforts in routine application of the new design. In simulation studies, the number of plot replicates dedicated to either NOEC- or ECx-derivation were varied as well as the number of samples per plot. Additionally, the number of treatments of the chemical to be tested (carbendazin, because it is the reference substance for earthworm field tests for more than 20 years) was also modified in order to cover a broad range. This study can be considered as the biggest earthworm test field studies ever conducted. In April 2017, the pilot study was started in a design with 30 plot replicates. After this pre-sampling two further samplings has been performed and the last sampling will be conducted in April 2018. First results of this project indicate a clear concentration-dependent effect of carbendazin on earthworms.

TH120 Soil ecotoxicology and ecological risk assessment in southern African mining landscapes

M. Mahore, North-West University / Unit for Environmental Sciences and Management; H. Ejsackers, WUR/NWU

Although there has been a remarkable development in the field of soil ecotoxicology and risk assessment (RA) models, it is debatable if these RA models are representative enough in order to utilise them on larger spatial scales, attuned to specific landscapes and ecosystems worldwide. An example of this is southern Africa where some soil ecotoxicological research has been done. To address this we will present the results of: An inventory of research on the ecotoxicity of metals toward soil life in southern Africa as a example, focussing on southern African soils, soil life and living conditions. The outcomes of an analysis of the geographical surroundings of gold and platinum mine waste deposits in South Africa The field study of open coal mining in and near a national park in Swaziland It is concluded that there is a limited body of information on southern African soil life, and most of these were laboratory based studies done by a small group of researchers. Future research with regards to incorporating the information available into a soil ecosystem assessment procedure is needed and recommended. It is recommended that a starting point to address this might be the development of site-specific guidelines for Ecological Risk Assessment (ERAs) taking into account landscapes, vegetation and faunal characteristics. From our studies in the surroundings of platinum and gold mine waste, we conclude that these wastes still contain considerable amounts of other chemical elements. The extraction methods, moreover, result in very alkaline or acidic conditions. Further the mine waste is very fine grained and therefore susceptible for wind erosion. Consequently these wastes, given the prevailing wind conditions in these areas, will be dispersed over a wide area causing risks for organisms in natural and built areas surrounding these deposit areas. The coal mine study illustrates that mining in or around natural protected area cause risks due to the irradiating impacts of wind and surface and ground water dispersal form the mined area. Therefore ERA should start to assess the impacts on the natural ecosystems present in the area, and compare these with the outcomes of a Potentially Affected Fraction of species PAF analysis. 

Key words: soil ecotoxicology, ecological risk assessments, mining, southern Africa

TH121 Establishment of tiered risk assessment approach of pesticides for soil organisms in China

J. Jiang, Nanjing Institute of Environmental Sciences, MEP; J. Zhou, Nanjing Institute of Environmental Sciences, MEP

The aim of the risk assessment for soil organisms is to prevent negative acute or long-term effects on soil functions and functionally most important species. The risk assessment approach established in China considers ecologically relevant groups of soil organisms, soil functions and their functions. This approach is applicable in a range of soil functions providing essential ecosystem services, e.g. organic matter breakdown and mineralization, water regulation in soil. The tiered approach is a valuable tool to quickly identify those pesticides which do not pose acute or chronic risk (in a certain area of ecotoxicology) on soil organisms – even under worst case assumptions, and to identify those that need more attention and further evaluations. All risk assessments presented are based on Risk Quotients (RQ), calculated by dividing the Predicted Environmental Concentration (PEC) by the Predicted no Effect Concentration (PNEC). This calculation takes into account, that beside the toxicity of a pesticide, the amount of this pesticide in the environment plays a major role when assessing a risk. If the RQ > 1, the risk is unacceptable and7 high risk assessment is conducted. If the RQ < 1, the risk is considered to be low and no further assessment and N - transformation assessment. High tier risk assessment mainly focusses on the litterbag test assessment and earthworm field test assessment. We have used this tiered risk assessment approach to assess the risk of more than 40 common used pesticides in China. Keywords: tiered, risk assessment, pesticide, soil organism

TH122 Ecological recovery and terrestrial Non Target Arthropods: abundance, functional roles and networks

M. Haen-Kissling, Eurofins-Mitot; S. Aldershof, Bioresearch and Evaluation; F.M. Bakker, Eurofins-Mitot

Terrestrial non-target arthropods exhibit a vast array of life history strategies and migration tactics. However, their home range is rather small, and thus, they are a good model group to investigate the factors which influence ecological recovery in risk assessments. Arthropod communities are not stable, but the numbers of species and individuals per species fluctuate over time and space. Part of the variability may be caused by the initial disturbance of the application of soil active compounds, which are intrinsic or due to biological interactions, as individuals are embedded in complex food and interaction networks. However, the recovery of a network depends on the fact that all ecological and functional roles within such a complex entity are still realised by a certain number of species (and their individuals). Usually, only abundance criteria are applied in ecological recovery investigations. For example, if numbers of individuals trapped are similar to a control group on two subsequent occasions, recovery is concluded upon. But if the proportion of one functional role (e.g. predators, parasitoids, pollinators or herbivores) in the focal group is far below the proportion of the same functional group in the control group, recovery is not...
TH132 Comparing effects of fludioxonil on non-target invertebrates using ecotoxicological methods from single-species bioassays to model ecosystems A. Hagerbäumer, R. Raschke, Bielefeld University / Animal Ecology; S. Hoß, Ecossa / Animal Ecology; W. Traunspurger, Bielefeld University / Animal Ecology. Lower tier toxicity testing used for risk assessment of plant protection products (PPP) is conducted with single species. Information from such toxicity tests are, however, limited to direct effects of the respective tested substances. Although the uncertainties regarding the protectiveness of these tests for in-situ communities are known, informations on effects of PPPs on community-level of non-target organisms are scarce. Model ecosystems, i.e. microcosms, are suitable to bridge this gap between single-species tests and field studies since they provide controlled experimental conditions and are able to demonstrate direct and indirect effects of the respective substances. In the present study, single-species toxicity tests and soil-spiked microcosms were used to comparatively investigate the toxicity of the non-systemic fungicide fludioxonil (FDO) on non-target soil organisms. Regarding soil invertebrates, nematodes are among the most abundant metazoan organisms and important decomposer organisms, which are suitable for risk assessments via various assay tools ranging from single-species toxicity tests to field studies, potential effect of FDO on these non-target organisms were assessed using standardized toxicity tests with Caenorhabditis elegans (ISO 10872) in spiked soil exposure and in-situ nematode communities, sampled from microcosms with FDO-spiked soils. In the standardized toxicity tests, FDO inhibited the reproduction of C. elegans dose-dependently, with a chronic 96-h EC50 of 363 mg kg⁻¹ (dry weight, dw) and a 96-h No Observed Effect Concentration (NOEC) of -1 (dw), which is comparable to the 28-d NOEC of Chironomus riparius in sediment (40 mg kg⁻¹ dw) and within the range of the 56-d NOEC of Eisenia fetida (20 mg kg⁻¹ dw) and 28-d NOEC of Folsomia candida (125 mg kg⁻¹ dw). In the spiked microcosms, distinct effects on in-situ nematode communities could be measured, with significantly lowered abundances in spiked soils, (40% and 50% reduction of nematode abundance in soils spiked with 300 and 600 mg FDO kg⁻¹ dw). Overall, this study provides new insights into the impact of the non-systemic fungicide fludioxonil on non-target soil organisms and demonstrated the general suitability of standardized toxicity testing on C. elegans in protecting in-situ communities.

TH124 To what extent do soil micro-arthropods facilitate OM breakdown in an arable field soil? - Implications on specific protection goal setting for soil risk assessment of plant protection products G. Pinzon, Bayer CropScience; J. Bender, Dow Agrosciences; T. Carro, FMG; H. Cunningham, Syngenta / Environmental Safety; A. Koutsafitis, ADAMA; S. Loustieti, Du Pont De Nemour Hells S.A.; M. Marx, Bayer AG Crop Science Division / Environmental Safety - Ecotoxicology; B. O’Neill, DuPont Crop Protection; A. Sharples, FMG Agricultural Solutions; F. Staab, BASF SE. Soil functional test systems provide valuable and ecologically relevant information for the risk assessment of plant protection products (PPP). Functional tests directly measure ecosystem functions and services which are provided by soils and soil organisms (e.g. organic matter (OM) degradation and mineralization). Focusing on structural endpoints in the risk assessment for PPP lacks a clear link to the protection goals derived from ecosystem services. Directly measuring soil functional and services offer a better understanding of potential services of non-target arthropods for in-situ communities, which may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependant. However, this issue does raise important questions particularly well suited to bridge the gap between single species tests and field studies since they provide controlled experimental conditions and are able to demonstrate direct and indirect effects of the respective substances. In the present study, single-species toxicity tests and soil-spiked microcosms were used to comparatively investigate the toxicity of the non-systemic fungicide fludioxonil (FDO) on non-target soil organisms. Regarding soil invertebrates, nematodes are among the most abundant metazoan organisms and important decomposer organisms, which are suitable for risk assessments via various assay tools ranging from single-species toxicity tests to field studies, potential effect of FDO on these non-target organisms were assessed using standardized toxicity tests with Caenorhabditis elegans (ISO 10872) in spiked soil exposure and in-situ nematode communities, sampled from microcosms with FDO-spiked soils. In the standardized toxicity tests, FDO inhibited the reproduction of C. elegans dose-dependently, with a chronic 96-h EC50 of 363 mg kg⁻¹ (dry weight, dw) and a 96-h No Observed Effect Concentration (NOEC) of -1 (dw), which is comparable to the 28-d NOEC of Chironomus riparius in sediment (40 mg kg⁻¹ dw) and within the range of the 56-d NOEC of Eisenia fetida (20 mg kg⁻¹ dw) and 28-d NOEC of Folsomia candida (125 mg kg⁻¹ dw). In the spiked microcosms, distinct effects on in-situ nematode communities could be measured, with significantly lowered abundances in spiked soils, (40% and 50% reduction of nematode abundance in soils spiked with 300 and 600 mg FDO kg⁻¹ dw). Overall, this study provides new insights into the impact of the non-systemic fungicide fludioxonil on non-target soil organisms and demonstrated the general suitability of standardized toxicity testing on C. elegans in protecting in-situ communities.

TH125 The role of source sink dynamics in the assessment of risk to non-target arthropods from the use of plant protection products G. Lewis, JSC International Ltd; S. Braaker, BASF France S.A.S.; C. Mayer, BASF SE / Ecotoxicology The concept of source-sink dynamics as a potentially important component of metapopulation dynamics was introduced in the 1980’s culminating in the paper by Pulliam (1988). Since that time, a considerable body of work has developed to consider its theoretical implications as well as to identify how it may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependant. However, this issue does raise important questions particularly well suited to bridge the gap between single species tests and field studies since they provide controlled experimental conditions and are able to demonstrate direct and indirect effects of the respective substances. In the present study, single-species toxicity tests and soil-spiked microcosms were used to comparatively investigate the toxicity of the non-systemic fungicide fludioxonil (FDO) on non-target soil organisms. Regarding soil invertebrates, nematodes are among the most abundant metazoan organisms and important decomposer organisms, which are suitable for risk assessments via various assay tools ranging from single-species toxicity tests to field studies, potential effect of FDO on these non-target organisms were assessed using standardized toxicity tests with Caenorhabditis elegans (ISO 10872) in spiked soil exposure and in-situ nematode communities, sampled from microcosms with FDO-spiked soils. In the standardized toxicity tests, FDO inhibited the reproduction of C. elegans dose-dependently, with a chronic 96-h EC50 of 363 mg kg⁻¹ (dry weight, dw) and a 96-h No Observed Effect Concentration (NOEC) of -1 (dw), which is comparable to the 28-d NOEC of Chironomus riparius in sediment (40 mg kg⁻¹ dw) and within the range of the 56-d NOEC of Eisenia fetida (20 mg kg⁻¹ dw) and 28-d NOEC of Folsomia candida (125 mg kg⁻¹ dw). In the spiked microcosms, distinct effects on in-situ nematode communities could be measured, with significantly lowered abundances in spiked soils, (40% and 50% reduction of nematode abundance in soils spiked with 300 and 600 mg FDO kg⁻¹ dw). Overall, this study provides new insights into the impact of the non-systemic fungicide fludioxonil on non-target soil organisms and demonstrated the general suitability of standardized toxicity testing on C. elegans in protecting in-situ communities.

TH126 Classification of uncertainty in ecological risk assessment of pesticides A. Hunka, Halmstad University / School of Business, Engineering and Science; M. Meli, ADAMA Agricultural Solutions; S. Pashami, S. Waara, Halmstad University. Uncertainty estimates are inherently built into any prospective risk assessment. Uncertainties need to be correctly recognized, described and presented to provide a basis for decision-making. One important factor to consider is that more data and experimental results often do not provide unequivocal acceptance of a risk. Thus, recognizing it, making this an issue of significant concern. The lack of straightforward presentation of all sources of uncertainty puts an extra burden on risk managers. This issue has been recognized by EFSA recently, but still there is very little research into classifying, visualizing and addressing uncertainty in ERA of pesticides. Currently EFSA recognizes standard and non-standard uncertainties in ERA of pesticides. This classification offers little insight into how those two categories impact ERA conclusions and future risk management decisions. In order to address this gap, we have undertaken an appraisal of a large subset of ERAs (102 up to date) conducted for approval of active substances at the EU level. We have been working on ERA data, conclusions on pesticide peer-reviews and Draft Assessment Reports of EFSA. We have collated and analyzed the most important sources of uncertainty, classify different uncertainties and link them to recognized points of concern, data gaps and risk management decisions. At the moment it is still unclear which sources of uncertainty influence the decision outcome more than others and our preliminary results indicate that it is possible to uncover non-obvious relationships between uncertainty and risk assessment outcomes. It is, for instance, possible to describe how different sources of uncertainty affect the process of ERA (e.g., duration, effectiveness of a Rapporteur Member State in producing a draft assessment report) and compare how uncertainty is addressed in risk assessment for different environmental compartments, especially soil versus ERA for aquatic organisms which is much more developed. We aim to provide a typology of recognized uncertainties in ERA and discuss how it could help inform the establishment of the surrogate reference tier and the subsequent calibration of lower tiers in the new risk assessment scheme for in-soil organisms, which is currently being developed by EFSA. Ultimately, we aim to link the typology of uncertainties in ERA to risk management techniques, in order to help ERA practitioners to better...
Derivation of soil threshold concentrations for arsenic: consideration of bioavailability through combination of ecotoxicological and analytical data


The German Federal Soil Protection Act (1988) defines precautionary values for seven metals which, if exceeded, indicate that concern for a harmful soil change exists. All precautionary values given in the German Soil Protection Ordinance (1999) are based on total concentrations ("aqu regia"). However, a realistic risk assessment of metals should consider their bioavailability in soil. Thus, the aim of this project is to connect bioavailable fractions of arsenic with ecotoxicological effect concentrations, taking into account soil properties (texture, pH, organic matter content etc.) and various metal extractions (1M NH₄NO₃, 0.01M CaCl₂, Ca(NO₃)₂; with ionic strength corresponding to soil solution, DTPA/CaCl₂, 0.43M HNO₃, plus aqua regia). Arsenic was chosen due to its high relevance as a soil contaminant, its low data availability compared to other metals and is an element of interest in European regulations.

The representativeness of the different extraction methods regarding metals and microbes and plants and invertebrates, according to ISO standard guidelines, allowing derivation of threshold values via an SSD approach. The results (given as NOEC, EC₅₀ and, preferably, EC₃₀ values), based on the six extraction methods, have been determined. The variation in EC₃₀ values based on nominal concentrations among the soils tested differed typically by a factor of 2 - 5 for the endpoints tested. The extraction strength of the different methods and soils differ at least by an order of magnitude in the order NH₄NO₃ < CaCl₂ < Ca(NO₃)₂ < DTPA < HNO₃ < aqua regia. Most soils and plants were the organisms reacting most sensitively, partly together with the Bacteria. Both invertebrate species were always less sensitive (i.e. EC₅₀ values (nominal concentration) > 250 mg As/kg soil) than microbes and plants except in one sandy soil (RefSoil-01A). Currently, chemical and biological results are combined in order to explain the observed variation in toxicity expressed as nominal or total As concentrations in soil. This information will be used to include As bioavailability into the derivation of precautionary values. The representativeness of the different extraction methods regarding bioavailable fractions as well as the properties of the different soils are checked as part of a more realistic risk assessment of metals in soils.

Activity based in-soil arthropod sampling

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Higher tier (field) assessment of effects on soil microarthropods relies strongly on the accuracy of the sampling methodology. Two main classes of trapping methods exist to date, these are either abundance-based or activity-based. Abundance-based trapping directly involves the collection of soil arthropods followed by heat extraction such as Berlese-Tullgren or McCayden methods. Activity-based sampling implies installing hypogean traps and collecting the catch at pre-determined intervals. Soil core sampling provides an instantaneous assessment of the fauna at the exact moment and at the very location of sampling, whereas hypogean traps provide an assessment of the activity in a wider area and over a longer time span. Clearly, higher tier sampling is used in other activities. Soil core sampling is an established and recommended method known to extract springtails, mites and some other small arthropods. Hypogean trapping is a relatively novel approach (cf Dehelean et al. SETAC 2016, Sims et al. 2016, Bakker et al. 2017) and seems to have a certain degree of selectivity. For purposes of method development and evaluation we have performed a comparative study in which soil core sampling and hypogean trapping (mine traps) were performed in the same fields. The study comprised both a hay meadow and an arable field. Soil cores were taken from the top 10 cm of soil, mine traps collected from various depths. With this contribution we will highlight the differences in species spectrum, numbers collected and variability observed with the different methods and discuss the implications for data analysis and interpretation.

The application of the CPCAT approach reduces shortcomings of effect detection for earthworm field studies

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The detection of microbial biomass activity is a pre-requisite for OECD laboratory studies that are designed to investigate the environmental fate of chemicals in soils. By determining soil microbial biomass prior to, during and after a study, the viability and suitability of the experimental soil can be demonstrated. Choosing the appropriate methodology for soil microbial biomass is critical for conducting successful environmental fate studies. One common method, referenced in the OECD guidelines, for determining soil microbial biomass is the fumigation extraction method. This method determines the carbon content of the soil biomass, via fumigation, using ethanol-free chloroform. During fumigation, cells are lysed by the chloroform, which results in a flush of organic carbon into the soil environment. This organic carbon is then extracted and quantified. Another suitable way of estimating soil microbial biomass is by substrate induced respiration. This method uses a suitable labile substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory response can be measured and the rates of substrate induced respiration can be used to estimate the active aerobic biomass, whereas in OECD 14240-2:1997, fumigation can extract carbon from both active and non-active biomass components. With such differences between methods, it is important to consider which method is more appropriate for determining soil suitability for environmental fate laboratory studies. Work is currently being undertaken by Smithers Viscent to investigate the relationship between the soil microbial methodologies commonly used for laboratory soil studies. The aim of this work is to better understand how the choice of soil biological methods relates to soil suitability, which will ultimately facilitate and refine our choice criteria when choosing soils for environmental fate studies.
The population dynamics experiment is a one-year study assessing the dynamics of Folsomia candida in artificial OECD soil at constant 20°C. The study started with 25 individuals of different age classes in 100 g OECD soil. Since then the population increase was measured on at least a monthly basis with five replicates per testing day. The food regime is adapted to the increasing population density to make sure that the maximum population level is achieved during the study. We will show a fast growth at the beginning of the experiment and expect to reach an oscillation around it by the end of the study. In a second experiment the vertical dispersion of F. candida in relation to food location is investigated. Transparent PVC columns were filled with on average 350 g of OECD soil up to a level of 20 cm soil column height and 86 F. candida of different age classes. Each column was closed with Parafilm on top and a gaze on the bottom with a small water reservoir beneath it to avoid desiccation. The initial humidity was set to 50 percent of the maximum water holding capacity of the soil. The columns were separated into six compartments at different heights: 1, 2.5, 5, 10, 15 and 20 cm. Septa in the middle (4th) and bottom (6th) compartment allowed for watering and feeding. We varied the location of feeding by four different regimes while all other parameters were kept constant. The columns were provided either with food at the top, in the middle, in the ground or at all three compartments. Our hypothesis is that food is a main trigger for the vertical distribution of F. candida in soil. Two of three large examination dates have been processed so far. The data confirms our hypothesis and the results of the study will present new data for the otherwise well investigated Collembola species F. candida.

**TH132**

Why zinc doesn't matter: habitat quality drives invertebrate response to zinc, not concentration

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The responses of organisms in soil ecotoxicity tests are often determined by the bioavailable concentrations of contaminants which they are exposed to. However, the direct effect of habitat quality on the performance or response of organisms in different contaminated soils is often neglected. Habitat quality is a measure of extent to which habitat promotes individual and population fitness. This study assessed the effect of habitat quality on mite, *Oppia nitens* exposed to different contaminated soils which was corrected for bioavailable metals. Forty-seven (47) soils were ranked into habitat quality by summing up the scores of enchytraeid and collembola survival and reproduction with the plant biomass in each of the soils. From the 47 soils, 18 soils were divided into three habitat quality groups based on high, medium and low habitat quality. The 18 soils were dosed with low to high concentrations of zinc and mites exposed to the soils for 28 days. Mite survival, reproduction and survival, and the mites' bioassay were determined after 28 days. Habitat quality did not change zinc bioavailability which remained at 2% across all three habitat indices. Instead, mite fitness improved with increasing habitat quality and mites were able to tolerate higher zinc body burdens in better habitat qualities. Furthermore, the zinc response (measured as the slope of the EC50) was more pronounced in lower habitat qualities. Our data suggest that habitat quality is more important than metal concentration for soil protection. Ecorestoration, rather than remediation, will likely be a more effective means of ameliorating zinc toxicity.

**TH134**

Effects of atmospheric hydrogen chloride and ammonia on Paronychius kimi (Collembola : Onychiuridae)

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As the use and distribution of various chemicals increases, there is a possibility of chemical accidents in Korea, the incidence of chemical accidents is also increasing. Damage caused by chemical accidents is not only widespread but also has a long-term impact, making it difficult to predict damage and respond appropriately however, there are very few studies on chemicals that can cause accidents. Especially for chemicals exposed to gaseous state, little is known about their environmental behaviors such as Collembola and earthworms. The experiment was carried out in PS container filled with 30g of soil according to modified OECD 232 guidelines. Investigating the effects of gaseous hydrogen chloride and ammonia on *Paronychius kimi* (Collembola), the test vessels with *P. kimi* were exposed to two different concentration of toxic substances in the enclosed chamber for 20 minutes. After exposure, the test vessels with *P. kimi* were transferred to an incubator (20°C, continuous darkness) in a closed state, and the mortality and reproduction rate of *P. kimi* were observed after 1 hours, 2 weeks, and 4 weeks. There were no deaths after 1 hour, but the mortality rate was increased over time from 2 weeks. Also, after 4 weeks, the number of juveniles produced by adults *P. kimi* were decreased as concentration-dependent manner. These results show that the long-term effects of gaseous phase chemicals can occur at concentrations that are not acutely affected.

**TH135**

Toxicity assessment of methyl ethyl ketone using earthworm and soil algae

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Methyl ethyl ketone (MEK) is a kind ofketone-based volatile organic compound and widely used as industrial solvent. There is a high possibility of leakage of this compound into soil environment, but few studies for ecotoxicity of MEK were present. This study evaluated the toxicity of MEK using earthworm Eisenia andrei and soil algae Chlamydomonas reinhardtii and Chlorococcum infusionum. Eisenia andrei were exposed with 1L of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including swelling, fragments, weakened, bleeding, and mucous secretion were measured. For soil algae, Chlamydomonas reinhardtii and Chlorococcum infusionum were exposed with 2.5 g of control or MEK soils in 15 mL glass test tube, and chlorophyll intensity was measured after 6-day exposed. As results, 7d-LOEC and 7d-EC50 of MEK to *Eisenia andrei* were calculated as 1136 mg MEK/kg dry soil and 1910 (1643.00-2221.58) mg MEK/kg dry soil, respectively. For soil algae, *C. infusionum* was more sensitive than *C. reinhardtii* for MEK; 6d-EC50 to *C. reinhardtii* and *C. infusionum* were calculated as 3400.44 (3132.01-3690.94) mg MEK/kg dry soil and 60.97 (51.19-72.62) mg MEK/kg dry soil, respectively. These results can be used for risk assessment of MEK in soil ecosystem. This work was supported by Korea Environment Industry & Technology Institute (KETI) through "The Chemical Accident Prevention Technology Development Project", funded by Korea Ministry of Environment (MOE)(No. 2016001970001). <strong>Key word: methyl ethyl ketone, earthworm, soil algae</strong>

**TH136**

Effects of endocrine disrupt chemicals (EDCs) to soil algae

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There were many data for endocrine disrupt chemicals (EDCs) for aquatic organism, but soil toxicity data of them were very limited. This study evaluated the effects of bisphenol A (BPA), bis(2-ethylhexyl)phthalate (DEHP), and nonylphenol used in the agriculture and factory. Soil algae *Chlorococcum* and *Chlamydomonas* were exposed at 0.5 g of control or exposed soils in 6-well plate. Algae were extracted for 1 day using algae culture medium after 6-d exposure, and the chlorophyll intensity was measured by fluorescence microplate reader. We observed that the BPA was most toxic following NP and DEHP. The effect of DEHP was insubstantial to *Chlamydomonas reinhardtii* and *Chlorococcum infusionum*. The results can be used for risk assessment of BPA, DEHP and NP in soils. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458) Key word: bisphenol A, bis(2-ethylhexyl)phthalate, nonylphenol, soil algae

**TH137**

Evaluation of reproduction tests of earthworms and enchytraeids exposed to sugar cane vinasse in natura and after pH adjustment

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The use of sugarcane vinasse as fertilizer in crops has been widely used in order to provide an adequate destination for this residue however, it has properties that can be prejudicial to the animals present in the soil, as already verified in numerous studies. Therefore, the objective of this work was to treat vinasse with lime (CaO) to adjust pH to 7.0 (neutral), in an attempt to reduce its toxicity for later use in the soil. In this context, the development of ecotoxicological tests presents itself as a tool of great assistance in the analysis of residues released to the soil. Thus, reproduction tests were conducted using animal soil biocatalysts to evaluate the effects of vinasse may have on reproductive behavior of these animals. Earthworms of the species *Eisenia andrei* (Annelida) and enchytraeids of the species *Enchytraeus crypticus* (Annelida); both tests were developed according to the protocols proposed in ISO 11268-2 (ISO, 2011) and ISO 16387 (ISO, 2013), respectively. In the reproduction tests, earthworms and enchytraeids exposed to vinasse in natura in occupation to the animals exposed to the treated vinasse there was an increase in the number of animals, which suggests that the vinasse treatment for pH adjustment was valid for this test. The reproduction test with *E. crypticus* exposed to the same conditions cited above also showed an increase in the number of individuals exposed to treated in biosassays vinasse compared to exposed to vinasse in natura. The results allow to infer that the pH adjustment of the vinasse to a neutral level was effective in reducing the toxicity of the residue for the tests of reproduction both in both species used, since the environment favored the reproduction of the animals tested.

**TH138**

Ecotoxicological Characterization of Nitrogen-Based Energetic Soil Contaminants

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Environmental Toxicology

We provide an overview of ecotoxicological effects of nitrogen-based energetic materials (EM) of notable ecological concern, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and 2,4,6,8,10,12-hexanitro-2,4,6,8,10,12-hexaazaisowurtzitane (CL-20), 2,4-dinitrotoluene (TNT), 1,3,5-trinitrobenzene (TNB), 2,4-dinitrophenol (2,4-DNT), 2,4-dinitrotoluene (2,4-DNT), 2,4-dinitrotoluene (2-ADNT), 4-amino-2,6-dinitrotoluene (4-ADNT), and nitroglycerin (NG). Ecotoxicological effects of these EMs were determined in definitive studies with Sassafras sandy loam (SSL) soil using soil invertebrate, terrestrial plant, and biological activity endpoints. SSL soil was selected because it has physicochemical characteristics (low organic matter and clay contents) that support very high relative bioavailability of organic chemicals. Data for reproduction (soil invertebrates), growth (plants), and critical soil processes (basal and substrate-induced respiration, litter decomposition) were independently analyzed using appropriate regression models to determine the EM concentration producing 20 percent decrease (EC20) in the measurement endpoint compared with carrier (acetone) control. Toxicological benchmarks developed in studies with soil invertebrate and terrestrial plants were used to derive draft Ecological Soil Screening Levels (Eco-SSLs) for use in screening-level ecological risk assessment of EM-contaminated soils. Additionally, we developed species sensitivity distributions (SSDs) for select EMs using toxicity data for all three soil ecological receptor groups (invertebrates, plants, and soil processes). These SSDs were then used for derivation of Soil Cleanup Values (SCVs). Based on the data derived from Ecological Soil Screening Levels developed in these studies will be submitted to the USEPA Eco-SSL Work Group for use in establishing soil invertebrate- or plant-based Eco-SSLs for the individual EMs, and will be made available for use in Ecological Risk Assessment of terrestrial habitats at U.S. Army testing and training sites and other military locations. The SCVs can provide site managers and regulators with a risk assessment tool which allows them to determine a specific SCV (protection level) that they wish to use to derive a site-specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH139

Organismal responses of oligochaetes in bacterial inoculum amended copper oxychloride spiked soils

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The excessive release of heavy metals such as copper via anthropogenic sources into the soil environment has raised some global concern. Copper oxychloride, a common agricultural metal-based fungicide applied to fungicidal and terrestial plants, contains 60% copper. Copper oxychloride soils, no distinct effect was observed on twenty-four hours pure broth cultures of the two bacteria strains (Achromobacter spanius and Serratia lappid) used in this study, the bacterial strains used (Achromobacter spanius and Bacillus cereus) were previously isolated from gold and gemstone mining sites and confirmed to tolerate to 200 mgkg⁻¹ Cu. Twenty-four hours pure broth cultures of the two bacterial strains were inoculated into fungicide spiked soils. Utilizing standard ISO and OECD protocols, 10 mature Eisenia andrei and Enchytraeus albidus were exposed separately into both unamended copper oxychloride spiked soils or H0 and 1000 mgkg⁻¹ Cu. Avoidance behavior, biomass, reproductive success, metal contents in soils and earthworm tissues were determined. Findings revealed that E. andreii in inoculated substrates (200 mgkg⁻¹) exhibited significantly higher (p < 0.05) preference and reproductive success was recorded. However, at 1000 mgkg⁻¹ copper oxychloride soils, no distinct effect was observed on both E. andreii and E. albidus in bacterial inoculated and non-inoculated substrates. In conclusion, Acrhomobacter spanius - Bacillus cereus bacterial consortium decreased the ecotoxicity of metal-based fungicide towards Enchytraeus albidus and Eisenia andreii at high concentration (HC) values (e.g. Hc5 or Hc50 protection level) that they wish to use to derive a site-specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH141

Characteristics of metal-tolerant bacterial plasminids from a platinum mine tailings dam

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The presence of mine tailings is problematic the development of both heavy metal and antibiotics resistance among microbes with resistant plasmids. Plasmids provide their hosts with a large array of phenotypes such as heavy metals and antibiotics resistance due to gene transfer. This study describes the characteristics of plasmids isolated from various bacteria that displayed an ability to withstand high metal concentrations. Isolated plasmids were individually transformed into E. coli JM109. The E. coli JM109 were evaluated for metal-tolerant capacities using a microdilution approach where the plasmid DNA concentration ranged between 11.75-118.06 ng/µl after extraction. Incompatibility groups were determined by subjecting plasmids to PCR amplification using IncQ, IncP-9 and IncW specific primers, where only IncW provided positive results. Minimum inhibition concentrations (MICs) were carried out to determine the ability of transformed E. coli JM109 to tolerate metals at varying concentrations. Results indicated that transformed E. coli JM109 developed ability to grow in the presence of several heavy metals. Some strains were resistant to high concentrations (+10 mM) of Ni(NO₃)₂, Pb(NO₃)₂ and Ba(NO₃)₂ with metal resistance order of Ni/Al(NO₃)₃/Pb/Bar+Mn+Cr³/Cu²+/Co²+/Hg. Moreover, protein profiling was used to determine the impact of plasmids on E. coli JM109. Proteins were extracted from both transformed and un-transformed E. coli JM109 and subjected to one-dimensional (1D) and two-dimensional (2D) SDS-PAGE. One dimension SDS-PAGE illustrated general similarity of the profiles except for two banding positions in the 30 to 35 kDa region where bands were present in the transformants that were grown in the Al/Ni alloy containing media. Two-dimensional electrophoresis (2D-PAGE) and gel imaging showed that some of the proteins were up-regulated while others were down-regulated. The largest numbers of proteins were from 15 – 75 kDa. Since the plasmids rendered the E. coli JM109 tolerant to metals, it can be concluded that the change in the protein profiles was due to the effects of the plasmids. Furthermore, that plasmids isolated from various heavy metal-tolerant bacterial species were successfully transformed into E. coli JM109 rendering the new metal-tolerant bacteria. These findings in this study characterized have advanced our understanding that these plasmids could be important reservoirs for resistant genes, and may hold significant biotechnology potential.

TH142

Sensitivity of the waterside species, Yuukkanura szepczyki (Collembola: Neanuridae), to cadmium and copper

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Collembola is the most abundant organism in the soil ecosystem and some species are used as ecotoxicological evaluation species for toxic substances in soil. However, Neanuridae species, which is one of the family of Collembola, are rarely studied as toxicity evaluation species. In this study, the toxicity sensitivity of copper and cadmium of Yuukkanura szepczyki, known as the species in which they live waterwheels, and their biomagnification and accumulation were examined based on the ISO guideline 11267. After 28 days of exposure to tested metals, LC50 for adult survival and EC50 for reproduction were estimated. These toxicity values of Y. szepczyki were also compared to those of other collembolan species (F. candida and Parachoromys kimi) reported in literature to investigate their suitability as a new test species in toxicity test. Not only the adult survival but also the juvenile predation of Y. szepczyki was observed in a concentration dependent manner after 28 days of exposure duration. Although the response of Y. szepczyki to the tested metals was not highly sensitive to the other collembolan species reported in literature, the study of the response of Y. szepczyki to chemicals in the soil is considered to be very important. Because their special habitat can provide an understanding of ecotoxicity against certain environmental conditions.

TH143

Drivers of copper and zinc availability and phytovailability in agricultural soils receiving long-term organic waste amendments

J. Son, K. Cho, Korea University / Division of Environmental Science and Ecological Engineering

Complex interactions between metals and soil properties make it difficult to apply to a biotic ligand model widely used in aquatic ecotoxicity studies. In this study, a terrestrial biotic ligand model (TBLM) was developed to predict the acute toxic effects of cadmium and zinc on the survival of soil collembolan Parachoromys kimi in a simplified soil solution system under the assumption that soil pore water is the main route of exposure to metals. After 7 days of exposure, survival and internal metal concentrations in P. kimi were determined. The free metal ion activity for each metal was calculated by the Visual MINTEQ using inputs of soil metal concentrations, cation and anion components of the soil solution, and pH of the soil solution. The toxicity of cadmium and zinc was linked to the fraction of biotic ligand occupied by metal (i.e. Cd⁰ and Zn⁰). The results showed that the fraction of the biotic ligand occupied by metal can be used to predict the metal toxicity, indicating the applicability of TBLM to explain metal toxicity to P. kimi in a simplified soil solution. Although the approach used in this study may be limited to soil solution, the use of TBLM can be a useful tool for investigating factors affecting bioaccumulation and toxicity of metals.
TH144 Toxic Effects of Cadmium on Chinese Cabbage, Folsomia candida (collombola) and their Prediction Modes in 18 Soils of China

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In this paper, we adopt 18 Kinds of typical soils in China, Chinese cabbage, folsomia candida (collombola) were used as the research object. The germination and root elongation of cabbage under different concentration of cadmium in soil were measured. The endpoint of the F. candida was reproduction. The result show that the soil properties significantly affected the dose effect curve of cadmium, soil pH is the main influencing factor; at the same time, we calculated the toxicity threshold and prediction models. This study has a guiding significance for the plant and invertebrates ecological risk prediction and assessment of heavy metal cadmium.

TH145 Do we plant protection products correctly? Impact of agrochemicals on non-target beetle, Bembidion lampros (Coleoptera: Carabidae)

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Intensification of agriculture and the widespread use of pesticides during the last few decades have led to significant reduction of the abundance of non-target arthropods (NTA), including the ground beetles (Carabidae), which are natural pest enemies in agricultural areas. Due to the growing demand for food, it is not possible at the moment to stop using pesticides. We need, therefore, to make every effort to ensure that they are used in a way that do not jeopardize NTA. In the present study, three commonly used pesticide formulations: Durban 480 EC, containing the organochloride pesticide aldrin; lambda-cyhalothrin, a pyrethroid insecticide; and cyanuric fluoride, used for the protection of sugar beets. The effects of aldrin, lambda-cyhalothrin, and cyanuric fluoride on the activity of the beetles were assessed. The results show that the soil properties significantly affected the dose effect curve of cadmium, soil pH is the main influencing factor; at the same time, we calculated the toxicity threshold and prediction models. This study has a guiding significance for the plant and invertebrates ecological risk prediction and assessment of heavy metal cadmium.

TH147 A Field Trial to Determine Effects of Thiamethoxam treated Sugar Beet Seed on the Non-Target Arthropod Fauna of Arable Land in The Netherlands

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The aim of this study is to assess the potential effects of thiamethoxam, applied as a seed coating to sugar beet, on the full fauna of naturally occurring non-target arthropods (NTAs) in a commercial arable field in The Netherlands when compared to a non-insecticidal control treatment. This is a three year study which began in March 2017 with the drilling of the sugar beet seed at two different seed treatment rates equivalent to a typical sugar beet seed loading and oil seed rape seed loading using plots of 2 ha each organized in 4 blocks 8 ha each (32 ha total study area). NTA field studies are important for investigating impacts of pesticides on populations, communities and different life stages of NTAs as realistic exposure concentrations of many species range from 0.01 mg/kg to over 100 mg/kg. In order to assess the regulatory acceptable risk of a pesticide to NTAs in-field a study should be designed in a way that enables an adverse effect to be detected if present. A toxic reference use is referred to use the test design is adequate to demonstrate persistent adverse treatment-related effects. Many of the chemicals historically used as toxic reference items with large historical datasets are now not available due to changing regulations, making it difficult to select a suitable toxic reference. Conducting such a study requires multiple sampling methods such as pitfall traps, mine traps, soil cores and sweep nets to account for different life histories of NTA species and a team of qualified taxonomists to identify all organisms. In this study NTA populations will be monitored for a three year period that covers at least two generations to enable the detection of any trans-generational effects that might occur. The current EU risk assessment scheme considers that effects on populations are acceptable for the in-field area above the threshold value of 50% if recovery or potential for recovery is demonstrated within 1 year. This study has been designed to enable the assessment of: (1) the magnitude of treatment effects on non-target
arthropod (NTA) populations, (2) the range of NTA taxa affected by the treatment and (3) the duration of treatment effects and the time period until populations recover. The evaluation will be based on (1) time to recovery (population density similar to control) and (2) persistence of effect (population growth similar to the control). Effects will be classified in accordance with De Jong et al. 2010.

TH148
Bioaccumulation kinetics of pesticides chlorpyrifos and tebuconazole in the earthworm Eisenia andrei in two different soils
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This study was conducted to investigate the bioaccumulation of two pesticides currently used in large amounts in the agriculture, the insecticide chlorpyrifos and the fungicide tebuconazole. The two compounds have distinct properties suggesting their different fate in the soil and bioaccumulation. Their detailed uptake kinetics in the model earthworm species Eisenia andrei were measured to find a sufficient length of exposure to achieve equilibrium in concentration between soil and earthworm and to compare two pesticides in two arable soils differing in the organic carbon (1.02 and 1.93% respectively) and clay content (10.7 and 20.7% respectively). Concentrations of the pesticides in soils and earthworms were determined by LC-MS/MS after QuEChERS extraction, which has shown to be rapid, simple and effective approach to determine broad spectrum of pesticides in soil and earthworm samples. According to our results, a steady state was reached after 3 to 5 days for both pesticides and soils. The values of bioaccumulation factors calculated at the steady state ranged from 4.5-6.3 for chlorpyrifos and 2.2-13.1 for tebuconazole. Bioaccumulation factors were also calculated as the ratio of uptake and desorption constant with results comparable with steady-state bioaccumulation factors. The results suggested that the degradation and bioaccumulation of tested compounds by earthworms was influenced by more factors than only the organic carbon content in soils. The clay content also probably contributed, namely to degradation of chlorpyrifos by clay-catalysed hydrolysis and to decreased bioavailability of tebuconazole by binding to clay minerals. The lower Koc and hydrophobicity of tebuconazole relative to chlorpyrifos probably led to higher availability of tebuconazole through pore water exposure. On the other hand, higher hydrophobicity of chlorpyrifos probably caused an increase in availability by its additional uptake via ingestion.

TH149
Effects of diuron and imidacloprid on eight nematode species
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To assess the impact of the herbicide diuron and the insecticide imidacloprid (insecticide) on ubiquist organisms at the basis of food webs, we performed multispecies toxicity tests using nematode species commonly found in soil and freshwater benthic ecosystems. Diuron and imidacloprid belong to the top 15 of the most frequently detected pesticides in French rivers. Both chemicals show an elevated DT50 (time to 50% degradation) in sediments, about 130 days for imidacloprid and more than 360 days for diuron. Concentrations with results comparable with steady-state bioavailability factors. The results suggested that the degradation and bioaccumulation of tested compounds by earthworms was influenced by more factors than only the organic carbon content in soils. The clay content also probably contributed, namely to degradation of chlorpyrifos by clay-catalysed hydrolysis and to decreased bioavailability of tebuconazole by binding to clay minerals. The lower Koc and hydrophobicity of tebuconazole relative to chlorpyrifos probably led to higher availability of tebuconazole through pore water exposure. On the other hand, higher hydrophobicity of chlorpyrifos probably caused an increase in availability by its additional uptake via ingestion.

TH150
Multigeneration effects of pentachlorophenol and 2,2',4,4'-tetrabromodiphenyl ether on Folsomia candida
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The multigeneration effects of pentachlorophenol (PCP) and 2,2',4,4'-tetrabromodiphenyl ether (DEBT) on the springtail Folsomia candida were evaluated. Multigeneration tests were performed in accordance to two different test methods. In the first method, the parental generation springtails (F0) were exposed to PCP or DEBT for 28 days. The first filial generation (F1) springtails were transferred to unpolluted artificial soil for 28 days and reproduced the second filial generation (F2). In the second method, the F0 generation were exposed for 10 days and then transferred to unpolluted artificial soil to generate the F1 generation. The F1 generation were also transferred to unpolluted artificial soil for 28 days and reproduced the F2 generation. For PCP, significant effects were observed on F1 and F2 generation in the first method and F1 generation in the second method. This suggests that PCP influences the reproductive capacity of adult springtails and the hatching of eggs or the mortality of juveniles. For DEBT47, significant effects were only observed on F1 generation in the first method, where shows that DEBT47 affects egg hatching through the bioaccumulative capacity of adults. The affected endpoints of springtails can be inferred by the two methods. PCP and DEBT47 do not influence completely the same endpoints.

TH151
Bioaccumulation of lead in earthworms: a comprehensive study to derive a bioaccumulation soil accumulation factor (BSAF) for risk assessment
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Secondary poisoning to mammals and birds is a critical pathway for risk assessment of Pb in soil. This risk is generally assessed for the food-chain soil =⇒ earthworms =⇒ earthworm eating predators. Therefore, a correct evaluation of bioaccumulation of Pb in earthworms is essential for risk assessment of Pb in soils under the REACH Regulation and a literature review of biota-to-soil accumulation factors (BSAF) for Pb in earthworm species was made. To ensure that biota Pb burdens are in equilibrium with soil Pb concentrations, only data from field studies or laboratory studies using soil and biota collected at the same field site were considered. Data from laboratory studies where Pb was added to the soil as a Pb salt were only used as supporting evidence. In total, 248 BSAF values for earthworms were identified that meet the reliability criteria, ranging from 0.01 to 22.05 (dry weight basis, median 0.23). Results are available for several earthworm species, belonging to different ecological groups of earthworms: anecic, endogeic and epigeic earthworms. No distinct differences in BSAF values across these groups could be identified. BSAF values are derived in a wide range of soils and the data available can be considered as representative for soils in Europe. The cation exchange capacity (CEC) is significantly correlated with BSAF values. No significant correlation with Pb content, pH, organic carbon content or clay content is observed. The significant negative regression between log BSAF and log CEC was confirmed by laboratory studies and is also consistent with the significant decrease in Pb toxicity observed for Eisenia fetida reproduction with increasing CEC of the soil. It was concluded to implement the effect of soil properties on BSAF by using the overall regression between log CEC and log BSAF in the risk assessment of Pb in soil. This yields a generic BSAF of 0.30 on dry weight basis, corresponding to 0.048 on a fresh weight basis, for the median eCEC value of 16 cmol/kg soil for European arable soils. BSAF values on fresh weight basis vary from 0.089 to 0.028 for soils with eCEC of 5 and 30 cmol/kg soil, respectively, corresponding to the 10th and 90th percentile of eCEC in European arable soils. Implementing effect of soil properties on BSAF improves consistency between assessment of secondary poisoning and direct toxicity of metals to soil organisms, where bioavailability corrections for varying soil properties are commonly accepted.

TH152
Hazard assessment of liquid organic hydrogen carriers in terrestrial environment
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A proactive environmental hazard assessment of liquid organic hydrogen carriers (LOHCs) – a novel energy system which can efficiently and relatively safely store and transport hydrogen – was conducted by characterisation of potential behaviours and ecotoxicities of these chemicals in soil environment. Adsorption properties of promising LOHC candidates including indoles, quinaldines, carbazole derivatives, benzyltoluenes and dibenzyltoluene in terms of carbon-water partition coefficients (Koc) were investigated via HPLC screening. Further characterisation was performed via adsorption isotherm modeling and soil column leaching with the examination of soil-water, soil-plant or soil-vertebrate interactions. The toxicity of Quin-2Me as examples. Soil ecotoxicity was estimated for the quinolines in the soil bacteria Arthrobacter globiformis and Collembola Folsomia candida in pore-water and soil exposure scenarios. The log Koc values generally increased following indoles < quinolines < carbazole derivatives < benzyltoluenes < dibenzyltoluene. The mobility of LOHCs was thus classified as highly mobile, moderately mobile or immobile. Adsorption isotherm and column leaching showed the strongest adsorption and retention of the partially hydrogenated form (Quin-2Me-Ph) in soils. The H-rich form (Quin-2Me-H10) appeared the highest leaching capacity through the soil followed by the H2-lean form (Quin-2Me) implying the risk of groundwater contamination. Ionic-interaction was considered dominant in the adsorption of Quin-2Me-H10 to soils given its high protonation at the soil pH; while hydrophobicity was the main force in the adsorption of its two analogues. No or only slight toxicity was found for the quinolines in the Arthrobacter at the highest test concentrations (500 mg L-1 and 750 mg kg-1 dry weight (dw) soil). Higher toxicity was found in the Collembola and malfornations
of cuticle in the pore-water scenario were observed. Dose-response modeling showed 10 < LC₅₀ < 100 mg L⁻¹ (liquid-only exposure) and 100 < EC₅₀ < 1000 mg kg⁻¹ dw soil (calculated soil pore-water based) of the quinolines assigning these chemicals to category “harmful” to soil organisms. Predicted no-effect concentrations showed 1–3 orders of magnitude higher the effective concentrations than the former suggesting potential risks of the chemicals toward the soil environment and proper monitoring is needed in the application of the LOHCs. Key words: adsorption, bioavailability, hazard assessment

THI15 Combining field measurements and biotest to assess lead and zinc phytoavailability in contaminated urban soils
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Along with the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soil. Due to the lack of adequate plant biotest at the time the guideline was published (i.e. in 2005), the guideline suggests to measure trace element phytoavailability in the aerial parts of plants collected in situ in contaminated and uncontaminated soils. The present study aimed at applying the guideline methodology with the combination of a recently developed plant biotest (i.e. the RHIZOtest) and field measurements to lead (Pb) and zinc (Zn) contaminated urban soils on which irrigation with treated wastewater was foreseen. Ten contaminated and uncontaminated soil samples (hereafter referred to as soil) were collected in representative sites expected to be irrigated with treated wastewater. The phytoavailability of Pb and Zn was estimated on each soil by measuring Pb and Zn concentration in the aerial parts of field-collected plants and by deploying the RHIZOtest and measuring the uptake flux of Pb and Zn in the whole plants exposed to soil. As expected, field-collected plants exhibited a large range of Pb concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently to be rejected for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytoavailability in the combination with field measurements was useful to assess the risk of high phytoavailability in contaminated urban soils.

THI154 Can approaches beyond the traditional ones characterize the effects on soil microflora provide an added value in the scope of regulation?

Along with the tightening regulation, side effects of chemical substances on the soil microflora focus on the determination of the nitrogen transformation (OECD 216). However, according to EFSA a more comprehensive risk assessment is required. We investigated whether a combination of several test approaches addressing various microbial aspects results in a better understanding of the fluctuation of the soil microflora after a threat and a more comprehensive risk assessment taking the new requirements into account. We considered ecosystem services and the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the functional microbial diversity: (i) potential ammonium oxidation activity (PAO) addressing a small, mainly autotrophic bacterial community with comparable low diversity; (ii) respiration activity of the heterotrophic microflora as indicator for the C-transformation with basal respiration activity and activity in the presence of carbon sources (glucose, cellobiose) as well as sulfur or nitrogen containing organic substances (cysteine, alanine); (iii) activity of selected exoenzymes (selection based on the carbon sources used in the second approach). The second and third approach were performed in microwell plates. The three functional approaches (i) PAO, (ii) C-transformation, (iii) exoenzymes seem to be a suitable assessment tool and can provide a benefit in the assessment of chemicals. The combination of results was dependent on the test concentration. The exoenzymes were the most sensitive indicator and seem to be a suitable early warning indicator. An increased concentration of the chemical responsible for the initial effect or a further impact can severely affect the microbial population. Additionally affected nitrifiers indicated a stronger damage. Effects in all three approaches indicated a severe impact. The high sensitivity of the exoenzymes in contrast to the respiration activity of the microbial cells could be due to their location outside the microbial cell and a lower protection level. However, also the small size of the ions as affecting substance has to be considered. In further experiments, the combination of results obtained with the three functional approaches have to be determined with additional chemicals. Due to the use of microwell plates the additional work load seems to be acceptable also for testing in the scope of regulation.

THI155 Re-calibration of the earthworm Tier 1 risk assessment of plant protection products - an update
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The prediction in tier 1 of plant protection products (PPP) is expected to increase due to revision of the PECsoil modeling guidance. The new EFSA guidance foresees to use worst case PECsoil values for each European regulatory zone considering a lower soil bulk density, a lower organic carbon content, and a reduced crop interception rate due to consideration of worst case wash-off assumptions. Furthermore, several different soil layers for which PECsoil values could be calculated are under discussion, i.e. 0-1 cm, 0-2.5 cm, 0.5 cm, and 0-20 cm soil depth. Calculated PECsoil values based on the new EFSA guidance are estimated to strongly increase, which might lead to an overly conservative tier 1 risk assessment. In a project published by Christl et al. (2016), results from standard laboratory earthworm reproduction tests are compared with the effect levels in higher tier studies for a range of active substances. This study shows the importance of comparing Zaccl values for PECsoil modeling guidance. The relevant soil layer for PECsoil modeling and assessment factor were adjusted to result in tier 1 protection of unacceptable field study effects. The results of this evaluation give clear evidence that considering a layer of 0-5 cm in combination with the currently used assessment factor of 5 would lead to an appropriate earthworm tier 1 risk assessment (Christl et al. 2016). It was also shown that the assessment factor is not only important for upper tier but also for lower tier to get intra- and interspecies variability in terms of the regarding correction of laboratory endpoints for lipidophilic compounds (logP > 2). A correction of endpoints by a factor of 2 is proposed by EFSA (2015, EFSA Supporting publication 2015:EN-924) for studies containing artificial soil with 5% peat (formerly only endpoints from studies with 10% peat were corrected for high logP). Furthermore, in its Scientific Opinion, EFSA (2017) proposed Specific Protection Goals for earthworms which include a maximum acceptable recovery time of 6 months for initial effects in field studies. This deviates from the current procedure of an acceptable recovery time of one year for earthworm populations. The dataset of 54 case studies was re-evaluated considering the new EFSA proposals and the new results will be presented.

THI156 Digging into the soil risk assessment of pesticides: current approach and its uncertainty
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According to the Uniform Principles (Reg No 546/2011) in the context of Regulation (EC) No 1107/2009, all possible sources of uncertainties should be considered when performing a regulatory assessment in the context of pesticides authorization. The current risk assessment for soil organisms, conducted according to SANCO/10329/2002, foreseees, at Tier 1, the application of a trigger value of 5. The uncertainty linked to this trigger value is due to the extrapolation of the endpoints from lab- to field. However, the current approach presents additional uncertainties. Test methodology for soil organisms only requires dosing verification after the application of the pesticide to the soil. The determination of the tested concentration at regular intervals is currently not required although it may be very relevant for a proper hazard characterization (e.g. bioavailability). In fact, as no true laboratory bioavailability procedures are available for spiked soils, possible losses of the pesticide may occur. In case further refinements of the risk are triggered, higher tier tests (semi-field or field studies) under more realistic conditions may be one option. Standardised field protocols are mainly available for earthworms. The available standardised field methods evaluate the effects on abundance and biodiversity of earthworms, taking into consideration the likely level of effects, the species/groups affected, population recovery (within 1 year) as well as information on the application and fate of the pesticide. The magnitude of effects is directly assessed in terms of risk without the application of any assessment factor. However, field studies only give a picture of a particular situation as effect manifestation and recovery are dynamic processes which depend on the local situation and time-scale. Additionally, an assessment at community level which takes into account interspecies interactions and indirect effects is currently not implemented as well as the statistical power of test is not properly evaluated. An approach aimed at defining a Regulatory Acceptable Concentration (RAC) could be useful to address those uncertainties and would allow the harmonisation of the risk assessment of the different taxonomic groups.

THI157 SETAC Soils Interest Group
M.H. Wagelmans, Bioclear earth

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (P)
A novel analytical method for simultaneous quantification of Bracken fern produced carcinogenic ptaquiloside-like compounds and their derivatives V. Kisielius, Metropolitan University College; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; M. Rodamer, Agilent Technologies; D. Lindqvist, L.H. Rasmussen, Metropolitan University College

Significant variety of toxic secondary metabolites produced by plants appear in chemical structures of glycosidic molecules. These compounds are highly water soluble and mobile in soils and sediments. In cases when toxic glycosides are persistent and released in high loads from vegetation, evaluation of the risk to aquatic environments adjacent to drinking water supplies is needed. Nevertheless, the identification of the exact chemical and fate of such toxicants are largely unknown. This study aims to identify the environmental risk factors that predetermine release of glycosidic natural toxins from non-agricultural lands to aquatic ecosystems. Bracken ferns (*Pteridium aquilinum*) are known to produce up to 6 kg/ha of carcinogen ptaquiloside. Previous studies demonstrate leaching of ptaquiloside from Bracken to soils and upper ground waters. The ptaquiloside-like compounds – pceauquiloside and caudatoside – have recently been studied in Australian Brackens. Except from a few positive samples included in the Australian study, there have been no reports of these compounds in Europe. We hereby report a novel method for quantification of ptaquiloside, caudatoside and pcesculentoside and their respective pterosin-derivatives (6 compounds in total) to be used for the aforementioned study. The novel LC/MS method (Agilent 1260 Infinity HPLC – System; Agilent InfinityLab Poroshell 120 EC-C18 semi-UPLC column (3.0x50 mm, 2.7 μm)), enables simultaneous determination of all 6 compounds with low limits of detection (1 ng/l) using loganin as an internal standard. The total time of analysis is 6 minutes and the system is operated under semi-UPLC conditions with a max. pressure of 400bar. Mobile phase with a low fraction of acetonitrile is applied (10% v/v). These features are favourable for high-throughput analysis and could be practically utilised in, e.g. water supply facilities. The method will be applied for studies of the spatial and temporal variation of the 6 compounds in in plants, soils and surface waters. The project is part of the European Training Network NaToxAq, investigating the natural toxins in waters from the perspectives of their physio-chemical properties, spatial and temporal variation, health risks and concepts of water treatment operations for their removal (Horizon 2020 Research and Innovation Programme - Marie Skłodowska-Curie, grant agreement No. 722493).

A novel method for ptaquiloside and pterosin B preservation in groundwater samples E. Zeleznik, University of Copenhagen / Department of Plant and Environmental Sciences; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; L.H. Rasmussen, Metropolitan University College

Analyzing natural toxins in groundwater is challenging due to their labile and unstable nature. Ensuring sample integrity for analysis is a critical step to facilitate trustful findings, and appropriate preservation methods need to be developed. This research focuses on the development of a preservation technique for ptaquiloside (PTA) and its degradation product pterosin B (PTB) in groundwater. Ptaquiloside is a carcinogenic compound produced by one of the five most common plants on the planet, Bracken fern (*Pteridium aquilinum*). It is highly water-soluble with almost no sorption to soil and sediment, and hence leaches to the aqueous environment. In turn, PTA can potentially contaminate groundwater, which presents a concern for human health if used as a drinking water source. Ptaquiloside is chemically unstable under acidic and alkaline conditions, making it difficult to collect and preserve for analysis. Thus, a controlled and well-designed preservation procedure can ensure its stability for the subsequent analyses is necessary. In order to develop a technique for preservation of PTA and PTB in groundwater samples, a Plackett-Burman experimental design is applied. This approach allows assessing the influence of a number of independent factors such as sample bottle type, test time, water type, pH, temperature and transportation conditions by a reduced number of experiments. In each of the experiments, a water sample with known concentration of ptaquiloside was treated with a preservation method and a recovery percentage of the compounds were evaluated by LC-MS system. This led to an optimal combination of factors for the preservation of the compounds of interest. We also performed robustness and range tests to quantify the precision, accuracy and linearity of the method. The optimized technique was further validated by applying it at field sites covering different groundwater types and different spiked toxin concentrations. By doing so, we are able to facilitate reliable investigation and monitoring of PTA and PTB in groundwater. In that way, we contribute both to the scientific discourse on the topic as well as offer reliable investigation and monitoring of PTA and PTB in groundwater. In that way, different spiked toxin concentrations. By developing this method, we facilitate accuracy and linearity of the method. The optimized technique was further interest. We also performed robustness and range tests to quantify the precision, concentration of PTA and PTB was treated with a predefined factor set, and a number of experiments. Therefore, a controlled and well-operated under semi-Quadrupole MS; Agilent InfinityLab Poroshell 120 C18 semi-UPLC column (3.0x50 mm, 2.7 μm)), enables simultaneous determination of all 6 compounds with low limits of detection (1 ng/l) using loganin as an internal standard. The total time of analysis is 6 minutes and the system is operated under semi-UPLC conditions with a max. pressure of 400bar. Mobile phase with a low fraction of acetonitrile is applied (10% v/v). These features are favourable for high-throughput analysis and could be practically utilised in, e.g. water supply facilities. The method will be applied for studies of the spatial and temporal variation of the 6 compounds in in plants, soils and surface waters. The project is part of the European Training Network NaToxAq, investigating the natural toxins in waters from the perspectives of their physio-chemical properties, spatial and temporal variation, health risks and concepts of water treatment operations for their removal (Horizon 2020 Research and Innovation Programme - Marie Skłodowska-Curie, grant agreement No. 722493).

Matrix-assisted laser desorption/ionization-time of flight mass spectrometry application for rapid screening of microcystins occurrence in northern Taiwan tap-water reservoirs W. Ding, National Central University / Department of Chemistry Microcystins (MCs) are the most common hepatotoxins and tumour promoters produced by freshwater cyanobacteria. Due to the damaging the liver through inhibition of protein phosphatases 1 and 2A, they pose a serious health threat to humans and animals, and even inducing death. MC-LR and MC-YR are probably the most concern and toxic microcystins. They are also widely distributed and detected in the freshwater system worldwide. In this study, matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF-MS) technique was developed for the rapid screening of these two compounds in two water reservoirs in northern Taiwan. In addition, solid phase extraction (SPE) was used for sample cleaning-up and target analytes enrichment. The extracted target toxins were separated on a C18 column with washing of 10% methanolic solution, and then eluting with methanol. The limit of quantitation of MC-LR and MC-YR was 0.06 μg/L, which was below the limits recommended by WHO guidelines for drinking water (1 μg/L). A preliminary result revealed that MC-LR and MC-YR were detected in two reservoirs water samples by using the developed method.

Smelly HABs: response-surface optimized HS-SPME/GC/MS method for monitoring multi-class HAB odor compounds in water C. Avagianos, M. Pisania, T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL

HABs are known to produce a wide range of malodorous compounds belonging to various chemical classes such as terpenoids, ionones, amines, aldehydes, ketones and sulfurous compounds. Such compounds have detrimental effects to the aesthetic quality of water, making drinking water unacceptable by consumers and damaging recreational and tourism enterprises in lakes. Although HAB odorous compounds are generally non-toxic to humans at environmentally relevant concentrations and they do not inevitably indicate the co-occurrence of cyanotoxins, there is need for water utilities and water authorities to apply effective methods for early-warning and control of odor events. The objective of this study was to develop and optimize an efficient method for monitoring of multi-class HAB odors in freshwaters using automated HS-SPME/GC–MS. The study focused on optimization of the SPME factors, including salting-out effect, pre-incubation and extraction times, extraction temperature and stirring rate. 20 model compounds of various chemical classes were used as indicators of the wide range of odorous compounds, ranging from volatile, early-eluting (e.g. alkyl sulfides) to late-eluting compounds (e.g. ionones). Factor effects on the responses (extracted ion peak areas) were assessed. Design of experiments (DoE) techniques included preliminary Plackett-Burman factorial designs for screening of significant factors, followed by a 4-factor Box-Behnken design to assess linear and quadratic main effects and factor interactions and to optimize responses. Optimization was based on the objective of maximizing the signal-to-noise ratio and the objectives for maximum sensitivity screening of the whole range or of certain classes/groups of compounds. Optimization experiments resulted in full-quadratic response models for individual compounds, while desirability functions can be
easily computed for classes of compounds. The most significant factor was extraction temperature, especially for volatile early-eluting compounds where fine-tuning of temperature is essential to achieve the required sensitivity. The optimized automated HS-SPME-GC/MS method is proved to be a valuable tool for high-throughput, efficient and sensitive non-targeted screening of HAB odorous compounds, while sensitivity is further enhanced when certain classes of compounds are targeted, e.g. when sensory pre-evaluation of samples is applied. Acknowledgements The authors thank CYANOCOST – COST Action ES1105 www.cyanocost.net

TH163 Suspected screening of cyanotoxins in freshwater by high performance liquid chromatography coupled to high-resolution mass spectrometry D. Filatova, IDAEA-CSIIC / IDEAE: m. picardo, IDEAE CSIC Barcelona / IDEAE; O. Núñez, Universitat de Barcelona / Department of Chemical Engineering and Analytical Chemistry; M. Farre, IDAEA-CSIIC / Environmental Chemistry Cyanobacteria are one of the components of normal microalgal assemblages in periphyton formation. The community distribution is affected by water quality, flow regime, climate, and geology. During the past decades, there has been a noticeable increase of cyanobacterial blooms, dominating in many freshwater bodies worldwide. Some cyanobacteria species are known to produce toxic secondary metabolites called cyanotoxins, which vary in structure and harmful properties (hepatotoxins, neurotoxins), and being a major concern for drinking water supply and recreational water use. The broad spectrum of cyanotoxins is microcystin (MCs) variants MC-LR, RR, YR, with MC-LR being the most toxic one. For this reasons, the World Health Organization appointed a guideline of 1 μg/L in drinking water for total MC-LR. In order to monitor levels of cyanotoxins and prevent both human poisoning and wildlife damage, suitable analytical methods need to be developed. This work presents the development of a sensitive, fast and robust method of analysis of cyanotoxins in high-throughput liquid chromatography coupled to high-resolution mass spectrometry (HPLC-HRMS). For the sample treatment of cyanotoxins, solid-phase extraction for multiple toxins has been employed, which was recently developed in our research group. The chromatographic separation was achieved using a C18 analytical column (150x2.1 mm, 5 μm) with methanol and water as mobile phase. The total chromatographic run was 15 min. The chromatographic separation was coupled to a Q-Exactive Orbitrap instrument (Thermo Fisher Scientific). The interphase used was ESI under positive conditions. The main advantage of high-resolution mass spectrometry will be the target analysis of 10 cyanotoxins, as well as the analysis in scan mass spectrometry to assess the potential presence of transformation products and other non-targeted toxins in the samples. This multi-toxin method has been developed and validated for freshwater cyanotoxins such as microcystins, nodularin, cylindrospermopsin, and anatoxin-a. The developed method was applied for the study and characterization of cyanotoxins concentrations in Catalonia freshwater reservoirs. Keywords: cyanotoxins, microcystins, high-resolution mass spectrometry.

TH164 Oligonucleotide probes for fluorescence in-situ identification of cyanobacterial cells in surface waters L. dejana, Water Research Institute National Research Council / National Water Research Institute; A. Barra Caraciolo, National Research Council / Water Research Institute; P. Gernini, National Research Council of Italy (CNR) / Water Research Institute; c. fajardo, Faculdad de Veterinaria, Complutense University Avenida Puerta de Hierro s/n, 28040 Madrid, Spain; M. Martin-Fernandez, UCM / Biochemistry and Molecular Biology; L. medlin, Marine Biological Association of the UK, The Citadel, Plymouth PL1 2PB, UK; G. Mengers, Natural Biotic SL; m. sacccu, Council for Agricultural Research and Economics (CREA), Agriculture and Environment Research Center (AA), Via di Corticella 133, 40128 Bologna, Italy; m. leitner, European Commission, DG Joint Research Centre, Directorate D Scientific and Technical Research Water and Marine Resources TP 121, Via E.Fermi, 2749, 21027 Ipera (VA), Italy. Harmful cyanobacterial blooms have been increasing in freshwater ecosystems in recent decades, mainly because of eutrophication and climate change. In some cases, some cyanobacterial species can produce toxins and this phenomenon can have a negative impact and pose a risk for ecosystem and human health. Of the 15 known cyanobacteria genera, more than 40 species produce toxins, which are natural compounds showing different chemical and toxicological characteristics. Cyanobacterial toxins are responsible for both acute and chronic poisoning in animals and humans. Among the main classes of cyanobacteria, microcystins are among the most frequently found in the environment. These toxins are accumulated mainly in the liver, but also in the intestines and kidneys and can be very dangerous for both animal and human health (Lucernini and Ottaviani, 2011). Fast and sensitive methods to identify unequivocally Microcystis aeruginosa and Planktothrix agardhii are very useful to discriminate these species with respect to the non-toxic cyanobacteria. For this purpose, we designed, developed and validated some oligonucleotide probes (GNPlankS02, PKAgD03, MicAerD03) for FISH (Fluorescence In-Situ Hybridization) analysis to detect these species in freshwater samples. The FISH probes were designed using the ARB software with the Silva database in the framework of the MicroCoKit project. We tested different fixative methods to minimise the natural autofluorescence from chlorophyll-a (Groben and Medlin, 2005) to visualize Microcystis aeruginosa and Planktothrix agardhii under a laser confocal microscope. Firstly, the FISH probes designed have been tested on pure cultures of M. aeruginosa and P. agardhii species in the lab, then the probes were successfully applied to natural samples collected from surface waters. Keywords: Microcystis aeruginosa; Planktothrix agardhii; FISH probes; algal bloom

TH165 Adequacy of EPI Suite prediction models to estimate physicochemical properties of natural toxins potentially present in surface water J. Rodríguez Lega, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry Natural toxins constitute a potential risk to water supplies in Europe. Only a few assessment methods exist for assessing risk of natural toxins. The need for a more streamlined way to assess natural toxins in water might be useful in a number of cases where risk assessment will be conducted in Europe. There is thus a need to conduct new risk assessments, especially to reflect possible effects of climate change on the distribution of agricultural plants throughout the continent and to reflect increasing prevalence of monoculture farming. Furthermore, screening-level assessment of many natural toxins that have been identified but not fully assessed is needed (Bucheli 2014). Persistence and mobility of natural toxins in water might be useful in environmental monitoring applications using techniques developed for environmental pollutants of anthropogenic origin, such as EPI Suite™ (US EPA 2017). Environmentally relevant partitioning properties of many natural toxins have not been experimentally determined. To model overall persistence of natural toxins in aquatic environments requires sorption coefficients (e.g., Koc) and estimates of their degradation rate constants in the aquatic environment that have been determined by experimental methods or estimated using quantitative structure–activity relationship (QSR) and quantitative structure–property relationship (QSPR) models. QSAR predictions should be considered carefully when applied to a set of chemicals that are structurally distinct from those that were used to develop the model. The establishment of an applicability domain of the models provides a range of chemicals where the predictions are expected to be reliable and based on interpolation rather than extrapolation, regarding the structure of the chemicals in the training set (Gramatica 2007). We present here an analysis of the applicability domain of selected EPI Suite™ QSAR models, and interpret the results with reference to natural toxins within these limits that could be included in a systematic prioritization of natural toxins in water according to their persistence and mobility. References Bucheli, Thomas D. 2014. “Phytoxins: Environmental Micropollutants of Concern?” Environmental Science & Technology 48 (22):13027–33. Gramatica, Paola. 2007. “Principles of QSR Models Validation: Internal and External.” QSAR & Combinatorial Science 26 (5):694–701. US EPA. 2017. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA. 

TH166 Cyanobacterial oligopeptides of environmental concern and (co)production dynamics R. Sanches Natumi, E. Vonwy, Eawag Swiss federal Institute of Aquatic Science and Technology / Department for Environmental Chemistry, E.M. Janssen, Eawag Swiss federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry Our ecosystems and drinking water resources are not only vulnerable towards anthropogenic pollutants. Natural toxins present an additional threat for which we still have comprehensive knowledge. Cyanobacteria can be induced in toxic blooms of natural toxins from various kingdoms, those produced by aquatic organisms have a direct entry into our water resources. More frequent and intense surface water blooms of cyanobacteria have triggered particular scientific interest in their secondary metabolites as potential aquatic toxins. The variety of cyanopeptides is well documented since the 1990s and the growing publication record reflects an increasing scientific awareness. Cyanopeptides can be divided into structural classes characterized by indicative monomeric building blocks. Cyanopeptides are by far the most intensively studied class of cyanopeptides. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides beyond microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides under different cultivation condition of common cyanobacterial strains. Our targeted LC-HRMS analysis of biomass samples of single strain cultures show that besides microcystins, cyclamides and various cyanopeptolins are co-produced. Our data shows the evolution of the
peptide abundance throughout the growth phase of single strains (e.g., *Microcystis aeruginosa* and *Anabaena flos-aquae*) and under different culturing conditions (e.g., N:P ratios and light intensities) by multivariate analysis. New insights into co-production dynamics offer critical information about cyanotoxin mixtures present during harmful algae blooms and with that critical knowledge towards comprehensive risk assessment.

**TH167**

Degradation of the carcinogenic ptaquiloside under alkaline conditions

D. Lindefelt, L. Rasmussen, Metropolitan University College

The carcinogenic ptaquiloside (PTA) is found in several species of ferns worldwide. The distribution and occurrence is well described for genus *Pteridium* (Bracken fern), in which all three parts of the fern PTA is suspected of causing Human gastric cancer. PTA is a non-sesquiterpene glycoside and is not sorbed by soils to a great extent (logKow of approx. -0.5). Hence, PTA can leach from Bracken stands. Leaching is most prominent during rain but baseline levels are found in streams in Bracken infested areas. Soil contamination and contamination of upper aquifers has been observed on a number of occasions. PTA may contaminate groundwater resources. Dissipation of PTA under environmental conditions is governed by a number of factors: Enzymatic activity; pH (hydrolysis); irreversible sorption/reactions; and sorption to clay minerals. Bacterial activity and hydrolysis are the most important mechanisms causing dissipation of PTA. The purpose of this study was to describe the underlying mechanisms for the hydrolysis of PTA and formation of reaction products under near-sterile alkaline conditions as found in calcareous aquifers. PTA (4,700ppb) was deglycosylated using 0.1010/10.0 M NaOH and 3 different 0.025M buffer systems (approx. pH 7-12; NaHPO4/NaH2PO4; pH regulated with 0.1M NaOH). Dissipation of PTA and formation of reaction products were monitored up to 200hrs at 25°C. PTA and the main reaction product pterosin B (PTB) was quantified by LC-MS using SIM- and TIC-modes. Formation of other reaction products was analysed semi-quantitatively using the relative area distribution of the main mass trace. Chemical rate constants are reported for degradation of PTA and species formation. Dissipation of PTA were pH dependent as previously observed. Addition of 0.01-1.0M NaOH results in immediate degradation of PTA and formation of a small amount of PTB plus two more reaction products. The concentration of PTB remained constant over time. PTB is the endproduct of hydrolysis in pure solutions. One reaction products was identified as the bracken diene (BDE), a ultimate carcinogen. BDE is formed immediately while the unknown is formed from BDE reaching stoichiometric balance within the timeframe of the experiments. Rate of formation were dependent on pH, as well as of the buffer system used. The results indicate that PTA under alkaline conditions will form carcinogenic reaction products that are stable in groundwater.

**TH168**

Experimental Determination of Octanol-Water Partitioning Coefficients of Natural Toxins

C.D. Schoenees, Agroscope / Environmental Analytics; K. McNeill, ETH Zurich / Institute for Analytical Chemistry and Pollutant Dynamics; T. Bucheli, Agroscope ART / Environmental Analytics

The octanol-water partitioning coefficient (Kow) remains one of the key parameters in environmental fate and risk assessment of organic chemicals for regulatory purposes. Based on predicted Kow values, many natural toxins are expected to be mobile in the aquatic environment. If such toxins are not retained well in soils, they may end up in freshwater systems, and be persistent enough to occur as natural toxins, with physicochemical and structural complexity due to large numbers of various functional groups, current estimation models for Kow, and other phase distribution coefficients show limited applicability. Thus, experimentally determined physicochemical property data are still of great value to regulatory organizations defining thresholds for potential environmental contaminants. In this study, Kow values are experimentally evaluated by both indirect and direct approaches based on well-established OECD methods modified for application in natural toxic analysis. A multi-step molecular size and functional group specific calibration procedure is applied in indirect evaluation of natural toxic partition properties based on chromatographic retention. Direct analysis of partitioning behavior is performed in a miniaturized shake flask system in standard HPLC vials. As HPLC based methods, both approaches show the capability to be largely automatized for more efficient, less error-prone analysis and thus allow the reliable determination of Kow in the for potential aquatic contaminants relevant range of log Kow from -2 to 5. Natural toxins for analysis comprise previously investigated mycotoxins and isoalvoflavonoids as reference compounds in addition to representative natural toxicants. Thus, experimental data will help in prioritization of toxics for further research activities, including field studies and lab-based characterization of fate processes e.g., within the current MC-ITN NaToxAg. 

**TH169**

Phytoxins as aquatic micropollutants: a procedure for prioritization

B.F. Guennhard, Agroscope / Environmental Analytics; J. Hollender, Eawag / Environmental Chemistry; M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; K. Hungermeier, University of Zurich / Department of Biological Engineering; T. Bucheli, Agroscope ART / Environmental Analytics

Phytoxins are natural toxins produced by plants with widely varying molecular structures and toxic effects. Despite possibly high concentrations of natural toxins in vegetation, crops and freshwater, they are not yet commonly perceived as environmental contaminants of possible concern. This far, environmental exposure and effect studies have only been conducted for a very limited number of phytoxins, and systematic and larger monitoring campaigns are completely lacking. A crucial challenge is to systematically identify among the plethora of phytoxins those that actually present a serious risk for the aquatic environment. For this purpose, we ranked 1586 phytoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behavior of the phytoxins. Toxicity was included as descriptor of the effect and parametrized by both plant, and estimated compound toxicity. Plant frequency, obtained from InfoFlora, was used to estimate the occurrence of all plant species producing a certain secondary metabolite class and serves as an approximation of exposure. To identify the phytoxins relevant for the aquatic environment we used a procedure, which systematically ranks substances suspected of causing Human gastric cancer. Pterosin B is formed from ptaquiloside upon hydrolysis. Similar pterosins are formed from caudatoside and ptesculentoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH5-7 - pterosin B will form as one of the main products of hydrolysis. At lower or higher pH other compounds may form from ptaquiloside. Pterosin B is not toxic, but is interesting as the compound can be used to assess previously non-exposed to toxic to be of primary interest or only rarely produced. Finally, the analysis identified several potentially problematic secondary metabolite classes such as saponins, steroids, the terpene classes triterpenoids and diterpenoids, and several alkaloid classes including pyrrolizidine alkaloids, isosquillamine alkaloids, terpenoid alkaloids or steroidal alkaloids. These phytoxins were characterized as toxic, frequently produced, mobile and persistent and we propose to consider them in further monitoring programs and risk assessments.

**TH170**

Sorption of pterosin B to soil materials

J. Andersen, L. Rasmussen, Metropolitan University College

Bracken ferns (*Pteridium sp.*) are considered environmentally problematic due to their content of the carcinogens ptaquiloside, caudatoside and ptesculentoside (the ptaquiloside group’). Brackens are classified by WHO/IARC in Group 2B due their carcinogenic properties at cellular level and due to their association with several veterinary diseases. Brackens cause bovine urinary bladder cancers and are suspected of causing Human gastric cancer. Pterosin B is formed from ptaquiloside upon hydrolysis. Similar pterosins are formed from caudatoside and ptesculentoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH5-7 - pterosin B will form as one of the main products of hydrolysis. At lower or higher pH other compounds may form from ptaquiloside. Pterosin B is not toxic, but is interesting as the compound can be used to assess previously non-exposed to toxic to be of primary interest or only rarely produced. Finally, the analysis identified several potentially problematic secondary metabolite classes such as saponins, steroids, the terpene classes triterpenoids and diterpenoids, and several alkaloid classes including pyrrolizidine alkaloids, isosquillamine alkaloids, terpenoid alkaloids or steroidal alkaloids. These phytoxins were characterized as toxic, frequently produced, mobile and persistent and we propose to consider them in further monitoring programs and risk assessments.

**TH171**

Modelling the fate of natural toxins in the soil using DAISY- a case study of ptaquiloside

D.B. Garcia Jorgensen, University of Copenhagen / Plant and Environmental Sciences; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; M. Styrcen, E. Diamantopoulos, P. Abrahamsson,
Cyanobacteria form blooms in freshwaters due to environmental pollution and can produce taste and odour compounds, but also substances that have been shown to be associated poisonings of pets, livestock, birds, wildlife and humans, as well as for other toxin classes such as nodularins, saxitoxins, cylindrospermopsin and anatoxins have also been shown to be susceptible to be removed by AOP treatment.

The most often reported AOPs for the removal of cyanotoxins include ozonation, (photo-oxidation), electrochemical oxidation, radiolysis and other novel approaches such as those based on non-thermal plasmas. The present paper summarizes pros and cons of AOP technologies for the removal of cyanotoxins from drinking water and presents the first experimental evidence characterizing the potential and novel AOPs for the removal of less explored cyanobacterial metabolites and their mixtures. Acknowledgement: Supported by NaToxAq (H2020 MSC ETN project agreement No. 722943).

Aflatoxins (AFs) are the most toxic group of mycotoxin and secondary metabolites of various species of Aspergillus that can occur in all agricultural commodities under appropriated field or storage conditions. These molecules can cause important health problems and have high potential toxic effects. A validated Enzyme Linked Immuno Assay (ELISA) to monitoring the presence of aflatoxin in the environment and often in high amounts. The related risks to humans depend strongly on the physicochemical characteristics, load and fate of the natural toxins in the environment. The aim of this work is to develop a modelling approach to predict the fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this work the model code DAISY, a soil–water–atmosphere model, has been used.

In the animal kingdom, the biosynthesis of retinoids and they are able to produce these compounds into their surrounding environment. Some species of algae, cyanobacteria and dinoflagellates have attracted much attention due to their ability to produce various classes of toxins. These toxins are of primary importance because they are often linked to large fish kills and the destruction of aquatic ecosystems. One group of the recently discovered cyanobacterial toxic compounds are endocrine disruptors compounds such as oestrogenic substances in the environment. The aim of this work is to develop a modelling approach to predict the fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this work the model code DAISY, a soil–water–atmosphere model, has been used.

University of Copenhagen

Natural toxins are gaining more interest in the scientific community as emerging pollutants. The reason behind is that they are released continuously to the environment and often in high amounts. The related risks to humans depend strongly on the physicochemical characteristics, load and fate of the natural toxins in the environment. The aim of this work is to develop a modelling approach to predict the fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this work the model code DAISY, a soil–water–atmosphere model, has been used.

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TH176
Impact of climate change drivers on toxin contamination and genotoxicity in Mytilus galloprovincialis: combined effects of warming, acidification and harmful algal blooms.
A. R. Braga, Biology Department CESAM, Aveiro University; C. Camacho, IPMA, LP.; V. Pereira, R. Marcal, A. M. Marques, Biology Department CESAM, Aveiro University; S. Guilherme, Biology Department CESAM, Aveiro University / Biomussels were exposed to G. catenatum, DNA damage in both gills and M. Pacheco, Biology Department CESAM, Aveiro University / Dept of Biology; P. Costa, IPMA, LP.
Mytilus galloprovincialis under current environmental conditions and at conditions simulating scenarios of climate change, namely warming, acidification and the combination of these two factors were exposed to paralytic shellfish poisoning (PSP)-toxin-producing Alexandrium tamarense. Shellfish toxicity derived from accumulation of algal toxins was assessed in mussels at the four treatments as well as the damage at DNA level via the comet assay. Mussels were acclimated for 24 days and then exposed to G. catenatum, during 5 days (uptake), followed by 10 days with non-toxic diet (elimination). The analyses of PSP toxins in the mussels were carried out by Liquid Chromatography with Fluorescence detection. The highest PSP content was observed at day 5 in mussels in the actual conditions (1493.8 ± 202.4 µg STX eq. kg⁻¹), which exceeded the international seafood safety limits (800 µg STX eq. kg⁻¹). Significantly lower PSP content was observed in mussels under climate change scenarios. The lowest levels (661.9 ± 22.8 µg STX eq. kg⁻¹) were found in warm-acclimated mussels, followed by acidification (761.2 ± 62.3 µg STX eq. kg⁻¹). However, interaction of both parameters did not reveal an additive effect. Lower toxin elimination was observed in warm-acclimated mussels. Genotoxicity was assessed in gills and hepatopancreas of mussels sampled at the end of each period. In mussels not exposed to toxic algae, the comet assay revealed highest damage levels in mussels under combined effects of warming and acidification at the end of the experiment (i.e. after 36 days). When mussels were exposed to G. catenatum, DNA damage in both gills and hepatopancreas significantly increased at an earlier stage, i.e just after the uptake period. The treatments representing the acidification scenario and the interaction of warming with acidification revealed higher DNA damage than the actual conditions, highlighting a synergistic impact. DNA damage decreased in all treatments at the end of the elimination period, although reduction was subtle in mussels under interaction of warming and acidification. This is the first study assessing the impact of the combined effect of warming, acidification and biotoxins in shellfish. In conclusion, it was provided evidences that changes of global conditions may lead to lower PSP contents, but also to slower elimination rates and to a synergistic effect on DNA damage implying possible consequences for the mussels populations.

TH177
Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems
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The eutrophication of aquatic ecosystems, associated to climate change, enhance the frequency and the severity of cyanobacterial proliferations. Cyanobacteria are photosynthetic organisms producing endotoxins such as neureotoxins, hepatotoxins, dermatotoxins, and cytotoxins, threatening target organisms and humans. The interaction and interactions microbially mediated effects on organisms is overall quite well documented. However, the neurotoxin β-methylamino-L-alanine (BMAA), suspected to be a causative agent in the human neurodegenerative disease amyotrophic lateral sclerosis (SLA), is less studied. The bioaccumulation of BMAA has recently been demonstrated with highly selective analytical methods in various marine organisms (zooplankton, mussels, oyster, fish), but rarely in freshwater organisms. Bivalves are known to consume phytoplanktonic species such as cyanobacteria or diatoms, both known to produce BMAA, and can be used as sentinel organisms to reveal the environmental contamination. A dual approach, in the laboratory and in situ, is used to evaluate the pertinence of the bivalves Anodonta anodonta, Dreissena polymorpha and Mytilus edulis as bioindicators of the contamination of fresh and estuarine waters by MCs and BMAA. The laboratory approach consist in the evaluation of the kinetics of BMAA and MCs accumulation and detoxification in bivalves at various times and concentrations of exposure. The in situ approach consist in the evaluation of the MCs and BMAA accumulation in caged bivalves along a river continuum from fresh to estuarine freshwaters and interconnecting estuarine and coastal areas used for mussel aquacultures. First results show MCs and BMAA biomarkers in laboratory-exposed D. polymorpha and A. anodonta, with varying kinetics. Freshwater and marine bivalves also accumulated MCs in situ and a MC transfer from fresh to estuarine waters occurred, highlighted by an accumulation in the marine bivalve M. edulis. The results of this project will facilitate the long-term tracking of the contamination of ecosystems by cyanotoxins, which will provide an advance in the knowledge about the ecodynamics of cyanotoxins and the chains conditions of human exposure.

TH178
Tetrodotoxin an Emerging Threat to Humans in the Mediterranean Area: First Detection in Italian Mussels
C. Dell’Aversano, University of Napoli Federico II, Department of Pharmacy / Pharmacy, L. Tartaglione, F. Virriale, University of Napoli Federico II / Department of Pharmacy; A. Penna, University of Urbino / Department of Biomolecular Sciences; M. Giacobbe, Institute for Coastal Marine Environment, CNR; S. Piggozi, A. Milandin, Fondazione Centro Ricerche Marine; P. Bordin, L. Biglino, Istituto Zooprofilattico delle Venezie; A. Turner, Plymouth University / Food Safety
Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of pufferfish (Tetraodontidae) [1]. Successively, TTX was isolated from other marine and terrestrial animals, as xanthid crab, trumpet shellfish, blue-ringed octopus, gastropods, starfish, and frogs. The wide distribution of TTX in genetically unrelated organisms has made TTX origin for long time controversial, with different kind of bacteria being identified as TTX-producing organisms [2]. Even Alexandrium tamarense – one of the paralytic shellfish poisoning toxins (PST) producing organisms – was proposed as potential biogenetic source of TTX [3]. Although fatal human poisonings following consumption of TTX-contaminated seafood have been reported so far only in Japan, the accumulation of TTX in fish, oysters and mussels collected in Europe (Spain, Portugal, UK, Greece) has been recently reported. So, in the frame of a collaborative study on evaluation of PST-related risk in the Mediterranean area, mussels collected in the Siracuse bay (Sicily, Italy) over a three year period (2015-2017), were analyzed by hydrophilic interaction liquid chromatography coupled with both high resolution and tandem mass spectrometry detection (HILIC-HRMS and HILIC-MS/MS). Both techniques highlighted the presence of high PST contamination levels, with samples collected in 2016 containing up to 10851 µg STX eq/kg. Unexpectedly, together with PST, tetrodotoxin was detected in Sicilian mussels. Although this was the first report of TTX in Italy, contamination levels found in mussels (0.8-6.4 µg/kg) were well below the regulatory limit of 2 mg. TTX eq/kg established for TTX in Japan. Interestingly, much higher contamination levels of TTX (413 µg/kg) have been detected in mussels collected in 2017 in the NE Adriatic coasts of Italy (Lagoon of Marano), in the frame of the monitoring programme for marine biotoxins regulated in the EU. [1] Wu Z, Xie L, Xia G, Zhang J, Nie Y, Hu J, Wang S, Zhang R. 2005. A new tetrodotoxin-producing actinomycete, Norcardiopsis dasonvillei, isolated from the cultured puffer fish Fugu rubripes. Toxicon 45:851-859. [2] Yasumura D, Yotsu M, Michishita T, Endo A, Kotak Y. 1986. Bacterial production of tetrodoxin and anhydrotetrodoxin. Agric. Biol. Chem. 50:793–795. [3] Kodama M, Sato S, Sakamoto S, Ogata T. 1996. Occurrence of tetrodotoxin and anhydrotetrodotoxin. Toxicon. 34:1101-1105.

TH179
The first report on neurotoxic anatoxin-a occurrence in cyanobacterial blooms in the Czech Republic
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Prototypical cyanotoxins such as microcystins have been extensively studied all around the world but there is still a lack of research on the occurrence, levels and risks of other toxic metabolites produced in harmful blooms of cyanobacteria. In this paper we present the results of the first survey focusing on less explored cyanotoxins, namely anatoxin-a, in the samples from the Czech Republic. Levels of cyanotoxins were analyzed in freeze-dried biomass collected during 2012-2015 in various reservoirs in the country. The focus was on blooms (total 34 samples) dominated by potential producers of anatoxin-a such as Dolichospermum sp. (syn. Anabaena sp.), Aphanizomenon sp. as well as blooms formed by less common cyanobacteria. The multi-target UPLC-MS/MS methodology was applied that allowed to analyze in parallel all major cyanobacterial toxins (microcystin-LR,
The aim of this study was to investigate the profiles of volatile and odorous compounds in natural waters and their transformation products. T&O are hazardous for tourism and the environment, as well as their transformation products. T&O incidents in freshwaters and in inland waters have been detected and sediments represent probably the source for the inocula of cyanobacteria blooms. To better understand and anticipate T&O incidents, monitoring should be extended to compounds beyond geosmin and MIB. Acknowledgement: The authors thank CYANOCOST COST Action ES 1105 www.cyanocost.net. C. Christophoridis acknowledges the program of Industrial Scholarships of Stavros Niarchos Foundation.

TH190
Toxic cyanobacteria species isolated from a freshwater reservoir in Sicily, Southern Italy. Implications for monitoring programs and risk assessment.

Sicily, in the middle of the Mediterranean Sea, is the largest Italian island and is characterized by a dry hot climate. During the forties-sixties of the last century several water reservoirs have been built for drinking and irrigation water, and some of them have been interested by harmful cyanobacteria blooms. However, monitoring programs have been discontinuous, and no recent data are available for most of them. Therefore, a quarterly two years survey of main lakes used for drinking and irrigation water supply started in 2016, with a complete (chemical, physical, microbiological and molecular) analysis of samples, according to the Italian D.Lgs 152/2006, complemented by a water toxicity assessment through a Vibrio fischeri ecotoxicological test (ISO 11348-3:2007). Lake Disuere (37°11’26”N 14°17’16”E) was the only one in which a persistent bloom occurred during 2017 summer. After the sampling when a Microcystis sp. bloom was first detected, the frequency of sampling was increased, to assess the risk of the exposed population and wild and domestic animals. Between mid-July and mid-September the composition of the cyanobacterial community changed dramatically. In July the bloom was dominated by Microcystis sp. and Cylindrospermopsis raciborskii (in the order of 10^7 and 10^7 cell/L, respectively), the only two species detected. By mid-Aug these two species disappeared and have been substituted by Anabaenopsis sp. and Plankthotrix rubescens, which in mid-Sept were still growing (10^6 and 10^7 cell/L, respectively). Disuere Lake is among the largest lakes, with a surface of 1,85 km^2 and a maximum depth of 31 and 15.2 m, respectively, due to landfill and increasing and persistent dryness, depth can be reduced as much as to 1 m. Cyanobacteria are not always present (from Nov 2016 until Jul 2017 no species has been detected) and sediments represent probably the source for the inocula triggering the blooms, as well as a sink-source for nutrients, in the agricultural area of the water catchment. Results on chemical (nutrients and cyanotoxins) and molecular analysis will be discussed with a risk-based approach, to determine the risk for health for the population and to plan future management strategies.

TH181
Cyanobacteria taste and odor compounds; a study in freshwaters of Greece.T. Tzouganaki, C. Christophoridis, EYDAP SA / WATER QUALITY CONTROL; J. Lemos, M. Manganelli, Istituto Superiore di Sanità / Dip. di Ambiente e Salute; J. Diaz-Alvarez, M. Panou, Aristotle University of Thessaloniki / School of Biology; S. Zervou, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; M. Pisania, EYDAP SA / WATER QUALITY CONTROL; C. Christophoridis, T.M. Triantitis, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; A. Hiskia, NCSR Demokritos; S. Gkiris, Aristotle University of Thessaloniki / School of Biology.

Cyanobacteria as well as eukaryotic algae produce a wide range of volatile metabolites with several of them being odorous, causing taste and odor (T&O) incidents in freshwaters and in finished drinking water. Classes of cyanobacteria T&O include terpenoids, ionones, amines, carboxylic and sulfuric compounds, as well as their transformation products. T&O are hazardous for tourism and recreational activities in lakes, they can result in production losses in aquaculture and they can degrade drinking water quality, making it unacceptable by consumers.

The aim of this study was to investigate the profiles of volatile and odorous compounds in natural freshwaters of Greece as well as in cyanobacteria strain cultures isolated from Greek lakes. To do this, analytical workflows combining targeted and non-targeted analysis based on automated HS-SPME/GC/MS for fast and sensitive detection of a wide range of T&O compounds were developed.

Samples of lakes and water reservoirs of Greece were collected for T&O analysis according to specified procedures. Samples of cyanobacteria cultures (50 strains) isolated from 15 Greek freshwater bodies were also taken for T&O analysis. Results showed that a wide range of T&O compounds were present in natural water samples and cyanobacteria strains. Examples of compounds (odors) include: trimethylamine (fishy), dimethyl-and trimethyl-sulfide (septic), methanol (septic), nocadazole (swampy), and b-ionones (floral). Interestingly, results showed that in surface water bodies of Greece geosmin and MIB have a minor role, while other T&O compounds having characteristic odor (e.g. fishy, swampy) may be more important. Based on the species of Dolichospermum sp. were found in all three anatoxin-a positive samples (different species in different samples - D. planctonica, D. smithii and D. flos-aquae). The phytoplankton communities of the anatoxin-a positive blooms were fairly rich in composition containing also Aphanocapsa sp., Aphanizomenon sp., Microcystis sp., Woronichinia sp., Sphaerosporesporia sp. In addition to CYN and anatoxin-a, the paper discusses concentrations of other above mentioned cyanotoxins and bioactive metabolites and their risks.

TH182
Determination of multi-class cyanotoxins in fish tissues.
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Cyanobacteria blooms are responsible for blooms, as well as their transformation products. T&O incidents in natural surface waters and water reservoirs. To better understand and anticipate T&O incidents, monitoring should be extended to compounds beyond geosmin and MIB. Acknowledgement: The authors thank CYANOCOST COST Action ES 1105 www.cyanocost.net. C. Christophoridis acknowledges the program of Industrial Scholarships of Stavros Niarchos Foundation.

The analysis of cyanotoxins in aquatic organisms, particularly in fish, has lately received increasing interest, due to environmental concerns and public health issues. This study presents the development and optimization of novel, sensitive and accurate analytical methods for the simultaneous determination of multi-class cyanotoxins i.e Cylindrospermopsis (CYN), Anatoxin-a (ANA-a) and Microcystins (MCs), in freshwater fish tissues. For the efficient extraction of selected cyanotoxins from fish tissue (muscle and liver), prior to LC-MS/MS analysis, several combinations of extraction solvents at different pH were tested. Additionally, various treatment techniques, i.e. protein precipitation using addition of salts and hexane extraction of lipids, were also tested in order to eliminate matrix effects and to maximize the recovery of the target compounds. Different SPE materials were evaluated for the maximum preconcentration of the compounds and in order to further eliminate matrix interferences. The effect of matrix components was evaluated by comparing LC-DAD and LC-MS/MS chromatograms under identical chromatographic conditions. Finally two extraction/clean-up methods were developed, i.e. one for the maximum recovery of selected MCs and one for CYN and ANA-a, offering maximum recoveries for the selected toxins. The developed methods were applied on fish samples, collected from Greek Lakes. The optimized method for MCs provided maximum recoveries 87% and 81%, for MC-RR and MC-LR, respectively. These compounds did not co-elute with several matrix components after the selected pretreatment/clean-up method, therefore matrix effect was minimal. CYN and ANA-a co-eluted with several matrix components. The matrix suppression effect due to lipid removal and the effect of ionones (floral). Interestingly, results showed that in surface water bodies of Greece geosmin and MIB have a minor role, while other T&O compounds having characteristic odor (e.g. fishy, swampy) may be more important. Based on the species of Dolichospermum sp. were found in all three anatoxin-a positive samples (different species in different samples - D. planctonica, D. smithii and D. flos-aquae). The phytoplankton communities of the anatoxin-a positive blooms were fairly rich in composition containing also Aphanocapsa sp., Aphanizomenon sp., Microcystis sp., Woronichinia sp., Sphaerosporesporia sp. In addition to CYN and anatoxin-a, the paper discusses concentrations of other above mentioned cyanotoxins and bioactive metabolites and their risks.

TH183
Effects of Asparagus aragiensis extracts on the fatty acid profile of two marine invertebrates.
C.O. Silva, Polytechnic Institute of Leiria; T.F. Simeos, S.C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria; M.E. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria.

Invasive alien species represent a worldwide threat to the integrity of native communities, which increasingly have important economical and global changes in food production concerns as chemical pollutants do, and are thus often referred to as biological pollution. The red seaweed Asparagus aragiensis exhibits a strong invasive behavior and it is included in the list of the “Worst invasive alien species threatening biodiversity in Europe”. This algae has been shown to produce a large diversity of heterologous volatile organic compounds with potent biological effects. It can be found on tide pools during the low tide, where its exudate released can cause physiological changes in marine organisms, in particular invertebrates, have proven to be a major source of unique fatty acids (FAs). Membrane lipids,
especially FAs have great structural diversity and high biological specificity, essential for every living cell, as sources of energy, as membrane constituents, or as metabolic and signaling mediators. FAs have long been used as food-web tracers, and, more recently, changes in FA profile have also been exploited to better understand how contaminants affect organisms in aquatic food-webs (Silva et al. 2017). In this study, the potential impact of A. armata exudates in the FA profile of two marine invertebrates was assessed. For this, after calculating the lethal concentrations of the algal exude, *Gibbula umbilicalis* and *Palaemon serratus* were exposed for 168 hours to non-lethal concentrations of this exudate. Consequently, the trends in changes of FA abundance and composition were evaluated separately in the body tissue of the snails and in the shrimps' hepatopancreas. As a result, different FA profiles between invertebrates but for both species the profile was influenced by exudate concentration exposure, with significant alterations being observed for several saturated FA and polyunsaturated FA like Acid Arachidonic (ARA), EPA or DHA. These alterations can represent an impact on these organisms’ cell function since some of these FA have important communication and signaling roles within and between cells. Fatty acid profile showed to be a sensitive and highly informative parameter to address effects of marine algal exudates toxicity in cohabiting invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

**TH184 Impacts of Asparagopsis armata on marine invertebrates: behavioral and biochemical responses**

C.O. Silva, Polytechnic Institute of Leiria; C.E. Silva, S.C. Novais, Polytechnic Institute of Leiria / MARE IPILeiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPILeiria

The introduction of non-native seaweeds outside their native distribution range, through human activities, has been causing documented negative effect on native species. The red algae *Asparagopsis armata*, with its invasive strategy including specialized cells capable of producing compounds with potent biological effects, is capable of inducing significant changes in terms of native community composition. This is specially occurring in rocky pools (intertidal zone) where *A. armata* releases several compounds that in these enclosed and extreme conditions are often adverse for other organisms such as other seaweed, vertebrates, and invertebrates leading to severe consequences for coastal ecosystems. The main objective of this study was to evaluate the potential impact of *A. armata* on marine invertebrates by exposing the common barn *Palaemon serratus* and the marine snail *Gibbula umbilicalis* to the exudate of this macroalga. The seaweed collected at the coast of Peniche, (Portugal) was left in laboratory tanks, for 12 hours, in the dark at 20°C±1. After assessing the lethal concentrations of the algae exudate, animals were exposed for 168 hours to non-lethal concentrations of this exudate and subsequently analyzed for biochemical biomarkers responses associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AchE) and energy metabolism (lactate dehydrogenase, LDH; Isocitrate dehydrogenase, IDH; electron transport system activity, ETS; content in lipids, proteins and carbohydrates). Also, behavioral endpoints were performed using the flipping behavior for *G. umbilicalis* and the avoidance behavior for *P. serratus*. The biomarker responses analysed on invertebrates showed an impairment of their physiological status after exposure to this algae exudate, with both species suffering from disruptions in their neuronal and energy metabolism functions, as well as from oxidative stress inducing damage in their macromolecules.Behavioural responses were also highly sensitive to *Asparagopsis* exudate exposure. These results represent an important step in the research of toxic exudates released to the environment and can serve as warning indicators of prospective effects of this macroalga on the invaded ecosystems under a global change scenario.

**TH185 Assessing consumption risks through cadmium-contaminated shellfish amplified by ocean acidification**

When, Kasozi, Masaryk University / Dept Medical Science and Environmental Biology; H. Lin, National Taiwan University; S. Chen, Chang Shan Medical University / Public Health

The purpose of this study is to assess the human health risk of Taiwan population through consumption of cadmium-contaminated hard clam and oyster amplified by ocean acidification. This study employed forecasted ocean surface pH from the coupled model to project potential projected emission scenarios representative concentration pathways 8.5, and Cd distribution as 0.001 – 2 µg L⁻¹ in Taiwan coast to estimate potential Cd accumulation of shellfish. A gender-specific physiologically-based pharmacokinetic model was developed to assess urinary and blood Cd concentration via daily shellfish consumption. The dose-response function was used to account for the prevalence of renal dysfunction and osteoporosis in response to human accumulated Cd in urine and blood. Results showed that median Cd accumulations under current and 2100 ocean acidification scenario were, respectively, 0.0009 and 0.0019 µg g⁻¹ for hard clam, whereas 0.0186 and 0.0210 µg g⁻¹ were estimated for the oyster. The urinary Cd concentration in female had potential 80% higher for ocean acidification scenario than that for non-ocean acidification. However, it was reported that exceedance risks of renal dysfunction and osteoporosis for gender-specific consumption only and whole groups under 2100 ocean acidification were not significant different with that of current non-ocean acidification scenario. This study concluded that ocean acidification was not likely to increase synergistically the renal dysfunction and osteoporosis of human health risk through shellfish consumption.

**TH186 Cyanobacterial toxins - a threat to the human respiratory tract?**

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Intensified occurrence of toxic cyanobacterial blooms is becoming a major human health threat. Microcystin-LR (MCLR) is probably the most frequent and abundant cyanotoxin detected in the environment, known to induce primarily hepatotoxic effects. Several studies have shown MCLR to induce respiratory problems associated with CYN occurrence. To investigate inhalation toxicity under the renal dysfunction and osteoporosis of human health risk through shellfish consumption.
exposures to LPS (10 μg/mL) also did not significantly decrease cell viability and neither MCLR nor LPS affected gap junctional intercellular communication in bronchial cell lines. Regardless MCLR cell uptake, the toxin was relatively less cytotoxic to human bronchial epithelial cells when compared to the effects of other cyanotoxins (e.g. cylindrospermopsin), or in comparison with other cell types (e.g. hepatic or neural cells). Further experiments should focus on more detailed characterization of MCLR uptake and on long-term effects of MCLR and LPS on inflammation-related endpoints. Inhalation toxicity of other harmful cyanobacterial blooms components and their complex mixtures, such as extracts and LPS isolated from different cyanobacterial strains and natural water blooms, should be also investigated in the future. The research was supported by the Czech Science Foundation Grant No. GJ17-23279Y and H2020-MSCA-ITN-2016 Project No.722493 NeToxAq.

TH188 Estrogenic and retinoid-like activity in stagnant waters M. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; T. Prochazkova, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / Research centre for toxic compounds in the environment; R. Priebojová, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment RECETOX; E. Sychorová, Masaryk University, Faculty of Science, RECETOX / Research Centre for toxic compounds in the environment; L. Sehnal, Masaryk University Faculty of Science RECETOX / RECETOX; M. K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; H. Hilscherová, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX

Cyanobacterial water blooms represent worldwide problem in many freshwater as well as marine ecosystems as producer of substantial amount of various bioactive compounds, some of which can cause adverse effects and pose risk to both aquatic organisms and human. Recent investigations indicate that cyanobacterial metabolites could include compounds with estrogenic and/or retinoid-like activity. Endocrine disruptive compounds can cause disturbance in hormone signalling and adverse effects in biota even at very low concentrations. Retinoids play a role as important signalling molecules which control vital cell processes like morphogenesis, development, reproduction or apoptosis. This study focused on freshwater ponds and reservoirs affected by water blooms and determined the estrogenic and retinoid-like activity of water by in vitro bioassay as well as concentrations of main estrogenic and retinoid compounds by LC-MS/MS analyses. Water samples from freshwater reservoirs and ponds with water blooms elicited estrogenic activity up to 2 ngEEQ/L. This activity could be only partly explained by the concentrations of analysed estrogenic hormones, alkyphenols and phytoestrogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ng REQ/L. We analysed the presence of nine retinoic substances, where 4-keto all trans retinoic acid and retinal were the most common forms detected in the samples. Retinoid-like activity was almost fully explained based on concentration and related activity of retinoic acid and related metabolites. However, researchers also suggest that still other compounds with retinoid receptor-mediated modes of action are present. Our study highlights the ability of common species of cyanobacteria to produce retinoids naturally and excrete them directly into the environment in concentrations that can reach hazardous level for vertebrates in aquatic environment such as fish or amphibians. The SOLUTIONS Project is supported by the Seventh Framework Programme (FP7-ENV-2013) of the European Union under grant agreement no. 603437.

TH189 Excitatory effects of 2,4 -diaminobutyric acid on leech Retzius nerve cell membrane potential S. Spašić, Faculty of Medicine, University of Belgrade / Institute for Pathophysiology; M. Stanojević, V. Nedeljkov, Faculty of Medicine, University of Belgrade / Institute for Pathophysiology Ljubodrag Buha Mihalović; M. Prostran, Faculty of Medicine, University of Belgrade / Institute for Pharmacology, Clinical Pharmacology and Toxicology; S. Lopčić, Faculty of Medicine, University of Belgrade / Institute for Pharmacology, Clinical Pharmacology and Toxicology; I. Jušić, Faculty of Medicine, University of Belgrade / Institute for Pharmacology, Clinical Pharmacology and Toxicology

Neurotoxicity of 2,4 – diaminobutyric acid (DABA), a non-protein amino acid, was first shown after isolation from Lathyrus and related seeds, but mechanisms of neurotoxicity were never completely explained. DABA is also produced by Cyanobacteria in aquatic and terrestrial ecosystems. In the light of scarcity of electrophysiological studies and ubiquitous presence of DABA-producing Cyanobacteria, we investigated this effect on the excitability potential of Retzius leech nerve experiments. Experiments were conducted on Retzius nerve cells of isolated segmental ganglia of the leech H. sanguisuga. Classical intracellular recording technique was performed. Cell membrane potentials were recorded using glass single-barrel microelectrodes and amplified with a high input impedance amplifier. DABA was administered in concentrations of 1, 3, 5 and 10 μM over a period of three minutes each. Input membrane resistance was investigated using clamp current technique by injecting hyperpolarizing current pulses through the recording electrode via a Wheatstone bridge unit. Application of 1mM DABA solution depolarized membrane potential by 5.01±0.43 mV (n=6, p<0.01), while 3 mM DABA produced depolarization of 9.84±1.38 mV (n=7, p<0.01), Rapid and substantial depolarization of membrane potential by 39.63±2.22 mV (n=9, p<0.01) was induced by 5 mM DABA, and administration of 10 mM DABA caused membrane depolarization of 47.05±4.33 mV (n=6, p<0.01). DABA had several times higher efficacy than Glutamate and J-β-methylaminol-L-alanine (BMAA) on our model. After washout, cells exposed to 1 or 5 mM DABA fully recovered, but only 20% of the cells treated with 10 mM DABA recovered. A current of 10 μM DABA there was no recovery. Applied in concentration of 5μM, DABA induced a decrease of the input membrane resistance by 8.09±1.51 MΩ (n=7, p<0.01). DABA elicits substantial dose-dependent membrane depolarization. Decrease of input membrane resistance indicates that this effect is a consequence of increased membrane permeability. At higher concentrations DABA induces increased functional change of neurons, confirming neurotoxic effect. As DABA is often produced together with BMAA and other cyanotoxins, some of their previously attributed neurotoxicity could possibly be due to effects of DABA and/or their synergy. Keywords: 2,4-diaminobutyric acid, Cyanobacteria, Retzius nerve cells, neurotoxicity

TH190 Generating ecotoxicity information on microcystins and prymnesins: A different approach J.M. Lazorchak, U.S. EPA / Office of Research and Development; H. Haring, Pegasus c/o U.S. EPA Cincinnati; N. Dugan, U.S. EPA / Office of Research Development; J. Allen, U.S. EPA / Office of Research and Development; T. Sanan, U.S. EPA / Office of Research and Development; A. Herrera, Echeverri and Ferrao (2015) conducted toxicity tests on several different cladoceran species using lyophilized phytoplankton samples collected from hydroelectric/drinking water reservoirs in Brazil. They found that reservoir samples with higher microcystin contents were the most toxic ones and that different cladocerans had different sensitivities to microcystin. In this study we have taken a similar approach but have used laboratory cultures of a toxin-producing strain of unicellular Microcystis aeruginosa, non-toxic producing filamentous strain of Anabaena flos-aquae and P. parvum. Each culture was centrifuged to separate cells from their respective culture media, then resuspended in moderately hard water. The M. aeruginosa cells were then frozen/thawed 3 times at 18°C. The P. parvum and A. flos-aquae cells were lyophilized. Forty-eight hour acute tests were conducted with Ceriodaphnia dubia, Haibella azteca larval Pimephales promelas and Neoleocome triangularis on both strains. A similar procedure was also used on lake water samples collected during peak bloom conditions. Current results show microcystin concentrations of 74 μg/L did not cause any significant acute toxicity to any of the four test species. The filamentous non-toxic producer A. flos-aquae caused significant mortality to N. triangularis and H. azteca (only when tested in Moderately Hard Reconstituted Water but not in Reformulated Moderately Hard Reconstituted Water) which are both grazer feeders. Mechanism of effect is undetermined at this time. August 2017 Lake Harsha bloom sample (300,000 μg/L) and high concentrations of MC-LR, N. triangulifer and L. micropus. Decrease of input membrane resistance indicates that this effect is a consequence of increased membrane permeability. At higher concentrations DABA induces increased functional change of neurons, confirming neurotoxic effect. As DABA is often produced together with BMAA and other cyanotoxins, some of their previously attributed neurotoxicity could possibly be due to effects of DABA and/or their synergy. Keywords: 2,4-diaminobutyric acid, Cyanobacteria, Retzius nerve cells, neurotoxicity

TH191 Proteomic analysis of rice plant exposed to long-term microcystin-LR exposure H.Z. Niu, Nanjing Institute of Environmental Sciences, MEP

Irrigation with cyanobacteria-blooming water containing microcystins (MCs) poses potential threat to the growth of agricultural plants. Rice (Oryza sativa L.) is an important grain crop and is widely grown for domestic consumption in China. However, large amounts of rice field in the middle part of China has been irrigating with cyanobacteria-blooming water. So far, the molecular mechanism of MCs induced inhibition in the photosynthesis and growth of rice remains unclear. In the present study, rice plants were exposed to 1.0 μg/L and 50 μg/L of microcystin-LR (MC-LR) in the hydroponic nutrient solution for 34 days. The proteomic profiles of rice leaves after exposure were analysed using tandem-mass-tag labelling and LC-MS/MS analysis. The results showed that a total of 298 differentially expressed proteins were found, 89 differentially expressed proteins of them in 1.0 μg/L MC-LR treatment group, and 289 differentially expressed proteins in 50.0 μg/L MC-LR treatment group. Different response characteristics of protein expression were found in rice leaves exposed to low-concentration (1.0 μg/L) and high concentration (50.0 μg/L) of MC-LR,
respectively, and the different biological pathways involved in the mechanism of MC-LR-induced toxicity to rice were revealed using GO Term and KEGG analysis. Exposure to 1.0 μg/L and 50 μg/L of MC-LR could disturb the photosynthetic and ribosomal pathways in rice leaves, causing the adverse effects on the normal growth and photosynthesis of rice. The significant alterations of the biological processes induced by the exposure to 50 μg/L of MC-LR were the inhibition of ribosome, porphyrin and chlorophyll metabolism, photosynthesis and terpenoid backbone biosynthesis related pathways, and the induction of thioredoxin, inositol phosphate metabolism, vitamin B6 metabolism and flavonoid biosynthesis related pathways in rice leaves. These results provided evidence of the molecular mechanisms underlying adverse effects in terrestrial plants exposed to water containing microcystins (MCs). Keywords: rice, microcystin-LR, photosynthesis, proteomics

Acknowledgments

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Developments in the use of bioassays for chemical and environmental risk assessment (P)

TH194

Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dreudoabraena veneta (Annelida)

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The aim of this work was to study the effects of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) on jacchia, a bivalve mussel and oysters. However, BMAA is an emerging toxin from which little data of neurotoxicity has been detected in this species. To compare the responses of the two species to the two toxicants, the tolerance to BMAA was first evaluated in jacchia, and a 20% depuration was also included to enhance the understanding of potential toxicity of the PFASs. The aim of this work was to study, in the sediment dwelling invertebrate Dreudoabraena veneta (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (lysozyme and lysosomal membrane stability), and at tissue level (GPX and MTs), following the exposure to two perfluorinated alkyl acids (PFOA and PFBS) for short (72 h) and long (14 and 28 days) times. The exposures were carried out in soil microcosms prepared with glass containers filled with 300 ml of soil humidified at 30% with PFOA or PFBS spiked water. For the 72 h tests the exposures were performed, at two different nominal concentrations, i.e. 30% of 1x or 10x MAC-EQS fw values (Maximum Acceptable Concentration-EQS calculated by the Italian Working Group for the derivation of Environmental Quality Standard (EQS)) while for the long time the PFOA, or PFBS, nominal concentrations were 30% of 5x MAC-EQS fw values. Different accumulation patterns were observed for PFOA and PFBS, with PFOA no longer accumulating between 14 and 28 days, while PFBS continues to be accumulated up to 28 days. Significantly higher coelomocyte mortalities than in the controls, with both compounds, were detected after the 14 and 28 days exposures. As for the lysosomal membrane stability significant decreases were detected both after the short and the long-time exposures. In the soft tissues proximity data don't show any relevant differences between control and treated organisms regarding the GPX activity. A significant MT total decrease was detected after PFOA exposure, both at 14 and 28 days while after PFBS exposure only at 14 days. As for MT, because it has been reported that PFASs seem to increase ROS levels, we determined not only the total protein concentration but also the oxidized fraction (MTox). A significant increase in the MTOX fraction in PFOA treatment after 28 days and in PFBS after 14 days was observed. Our results show, for this invertebrate organism, a higher PFBS bioaccumulation than PFOA and significant exposure effects to the two PFASs both in coelomocytes, the main immunodefensive system cells of the organism, and in the soft tissues. Further studies are planned to explore the mechanisms underlying these results.
risk management framework for addressing potential environmental management issues of PFAS.

TH196 Interpretation of bioassay results in the context of the soil quality TRIAD approach. N. Pandur, P. Pardard, INERIS, S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances; P. Pandur, INERIS / Expertise and assay in ecotoxicology unit

The recently standardized method ISO 19204 “Soil quality – Procedure for site specific ecological risk assessment of soil contamination (Soil quality TRIAD approach)” describes in a general way the application of three combined lines of evidence (chemistry, ecotoxicology and ecology) along a tiered approach. Regarding the ecotoxicological component, the TRIAD approach consists in carrying out a battery of bioassays on soil samples and to scale the results from all bioassays to calculate an ecotoxicological combined risk score In order to evaluate its applicability and the relevance of the proposed tools, INERIS used the soil quality TRIAD approach on an applied case: an open mine operated for 60 years and which the activity stopped about 100 years ago (the “TRIPLE” project - Procedure for site delivered the enhancement of protonation for both GSH and GSSG. With the p of reduced form (GSH) to oxidized form (GSSG) is one of important external of cells. Regarding toxicological effects induced by oxidative stress, ratio of reduced to oxidized glutathione (GSH/GSSG) is a biomarker of oxidative stress and can be used to assess the cellular ability to maintain homeostasis under oxidative conditions.

Among the conclusions, it was noticed that the selection of the control soil may have a significant influence on the expression of the results and therefore on the risk assessment. This impact is particularly obvious for the assessment of a heterogeneous site and for the first TIER (screening level) of the TRIAD method. This statement is illustrated by observing the consequences on the assessment conclusion when the results of bioassays are expressed according different control/reference soils.

TH197 Estimating the hazardous concentrations of nonylphenol for soil ecosystem protection with predictive approach J. Kaak, J. Mood, D. Kim, Konkuk University; R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science

Nonylphenol is known as a xenoestrogen but is still used for pesticides, detergents, surfactant cleaners and packaging. However, few researches on soil ecotoxicity of nonylphenol were reported. In the present study, we conducted a battery of bioassay, generated soil ecotoxicity data and then estimated soil hazardous concentration for nonylphenol for soil ecosystem protection based on species sensitivity distribution (SSD). For the acute assay, eight soil species from six different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae, secernentae, classelata and colembolla) were tested. Also, for the chronic assay, four soil species from four different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae and collembs) were investigated. Finally, acute and chronic hazard concentrations for HCH, HCB, HCB, HCB were suggested for protection of soil ecosystem. These values can be applied to environmental risk assessments for nonylphenols. This study was funded by the Korea Ministry of Environment (MOE) - the Environmental Health Action Program (14GS0144S8).

TH198 Organophosphate Triesters and Selected Metabolites Enhance the Binding of Thyroxine to Human Transthyretin In Vitro K.L. Hill, Intrinsic / Department of Biology; R.J. Letter, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division; T. Hamers, Vrije Universiteit Amsterdam, Institute for Environmental Studies (IVM) / Department of Environment and Health; J. Kamstra, NMBU / BuSam; W. Wilmore, Carleton University / Department of Biology

The toxicological properties of organophosphate (OP) triesters that are used as surfactant cleaners and packaging. However, few researches on soil ecotoxicity of nonylphenol were reported. In the present study, we conducted a battery of bioassay, generated soil ecotoxicity data and then estimated soil hazardous concentration for nonylphenol for soil ecosystem protection based on species sensitivity distribution (SSD). For the acute assay, eight soil species from six different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae, secernentae, classelata and colembolla) were tested. Also, for the chronic assay, four soil species from four different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae and collembs) were investigated. Finally, acute and chronic hazard concentrations for HCH, HCB, HCB, HCB were suggested for protection of soil ecosystem. These values can be applied to environmental risk assessments for nonylphenols. This study was funded by the Korea Ministry of Environment (MOE) - the Environmental Health Action Program (14GS0144S8).

TH199 In Vitro and In Silico Competitive Binding of Brominated Polyphenyl Ether Contaminants With Human and Gull Thyroid Hormone Transport Proteins K.L. Hill, Intrinsic / Department of Biology; M. Mortensen, NTNU University / Department of Biology; D. Tcelechiel, Accustandard; W. Willmore, Carleton University / Department of Biology; I. Sylte, The Arctic University of Norway / Department of Medical and Health Sciences; M. Aukrust, Norwegian University of Science and Technology / Biology; R.J. Letter, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division

Tetradeacabromo-1,4-diphenylbenzene (TebDb-2,4-DiPhOBlz) is a highly brominated additive flame retardant (FR). Debrominated photodegradates of TeDb-2,4-DiPhOBlz have been shown to be enzymatically hydroxylated in vitro in herring gulls (Larus argentatus) liver assays, including one metabolite identified as 4'-OH-2,2',4'-tetrabromo-2,4-DiPhOBlz. Chemically related methoxylated tetroxobromo- to hexabromobioether compounds are known contaminants in herring gulls from the Laurentian Great Lakes of North America. To our knowledge, nothing is currently known about the biological effects of these polybrominated (PB) DiPhOBlz-based compounds. The present study investigated the potential thyrotoxicogenicity of 2,2',4'-diarylphenyl ethers. Three strains of S. ovejecta – and hydroxylanogenues, using an in vitro competitive protein binding assay with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB).

Para-OH-tetrabromo-DiPhOBlz was found to be capable of competing with thyroxine (T4) for the binding site on human TTR and ALB. The para-MeO-tetrabromo-DiPhOBlz and the tetrabromo-DiPhOBlz were much less competitive than the parent compound. This finding suggests a novel mechanism of OP ester toxicity via T4 binding enhancement, and possible dysregulation of T4 metabolism interactions.

TH200 Phosphine changes cytochrome c oxidase in Sitophilus oryzae K. Kim, H. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee, Kyungpook National University

Phosphine resistance in the stored product insect pests has been reported over the world. In South Korea, Sitophilus oryzae has been developed phosphine resistance after the severe use of phosphine. In this study, how S. oryzae survived under the recommended dose of phosphine and we assessed the biochemical and molecular mechanisms for referring phosphine resistance. Three strains of S. ovejecta were prepared as control groups (C), medium-resistant group (MR), and strong resistant groups (R) for this study. One target sites of phosphine is cytochrome c oxidase (COX) and we analyzed the enzyme activities within the three strains. The highest COX activities were found in R groups with about 1.5-fold increase when compared to the controls. IC50 values on the COX activity by ethyl formate, one of COX inhibitors, was 2.82, 3.71 and 6.05 μM for C, MR and R strains. Lineweaver-Burk plot for COX using ethyl formate exhibited different modes from R strain to C strains. And six genes cat, Jhip, Voltagge, casp, wnt7, wnt11 were analyzed using RT-PCR for comparing gene expression and cat gene was dramatically down-regulated in the R strain. Jhip gene expressing juvenile hormone inhibable gene was differentially expressed in the two phosphine-resistant strains, with a stronger effect in the MR strain, but it was not so big different. Three biomarker enzymes such as acetylcholinesterase, glutathione S-transferase, and carboxylesterase activities were also determined within the three strains. Only glutathione S-transferase activity decreased in the R strain. Taken together, phosphine resistance in S. oryzae may be related to the changes in COX enzyme and up-regulation of Jhip gene expressing juvenile hormone inhibable protein.

TH201 Effects of additives in mobile phases in simultaneous analysis of glutathione and glutathione disulfide by HPLC-MS/MS S. Baik, KIST Europe / Environmental Safety Group; Y. Jung, KIST-Europe; Y. Kim, KIST Europe / Environmental Safety Group

Glutathione is an important non-protein compound and existed in both internal and external of cells. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) is one of important biomarkers. Among all available assays to detect and quantify GSH and GSSG, using high-performance liquid chromatography (HPLC) coupled with mass spectrometry (MS) is very essential with the development of high performance and sensitive analytical methods. GSH and GSSG are usually analyzed in positive ionization in electrospray, and formic acid can be a general additive in mobile phases for a better protonation in positive ionization mode in MS. In this work, we investigated the effects of additives other than formic acid for a better understanding to enhance the ionization of GSH and GSSG in the gas field of MS source. With the presence of formic acid only, as a result, protonation of GSSG was very limited. However, using formic acid and ammonium acetate together in mobile phases delivered the enhancement of protonation for both GSH and GSSG. Furthermore, as increasing the concentration of ammonium acetate from 5mM to
50 mM, sensitivities of GSH and GSSG were increased from 0.0034 to 0.0072 and 0.028 to 0.046, respectively. Detection limits of both GSH and GSSG were also significantly lowered as using higher concentration of ammonium acetate. This indicates that producing ammonium adducts followed by dissociating ammonium ions from adducts to protonate GSH and GSSG is important mechanism for protonation of these compounds with using ammonium acetate as a mobile phase additive. This enhanced sensitivity was used peptides (ZFL) to investigate the recovery of both GSH and GSSG and achieved more than 100% recovery for GSH and around 100% recovery for GSSG. The achievement of higher recovery of GSH than 100% was because ZFL itself might not be oxidized to form GSSG. In addition, same method was also applied to ZFL exposed to different concentrations of a target chemical as well as 6 mg/L of H2O2, a negative control. The lowest concentration of GSH in this work was 5.0 ng/ml higher than its detection limit, 2.0 ng/ml. This is meaningful because it could not be achieved by other conventional methods and assays with higher detection limit than its original concentration. Therefore, we can conclude that our method could avoid underestimation to quantify biomarkers such as GSH and GSSG.

TH202 Rapid analysis of bivalves’ xenometabolome using High Resolution Mass Spectrometry

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A wide variety of contaminants and their metabolites are released to the environment every day from residential, commercial and industrial uses. They are simultaneously present at different levels in aquatic ecosystems making a “cocktail” of hazardous substances. These xenobiotics interact with wild organisms and may be bioaccumulated. They can have negative implications from an environmental point of view, affecting wild life, but also they may be of great concern from a human health perspective, when they accumulate in highly consumed organisms like bivalves. Given that it is unrealistic to assess every possible combination of chemical substances accumulated by organisms, the major challenge now is to develop systematic ways of addressing these chemical mixtures, and to identify priority mixtures of potential concern. For this purpose, the profiling of the xenometabolome, or range of xenobiotics and their metabolites in an organism exposed to environmental contaminants, seems to be the way forward. In the present work, for the profiling of the xenometabolome, a fast analytical method has been developed for the extraction and identification of priority contaminants in bivalves from Ebro Delta, Spain. A literature research was done in order to gather all the information available regarding the Ebro Delta and possible sources of contamination. Taking into account the information a mixture of compounds representative of the different contaminant sources identified in the area was selected. This mixture including pesticides, plasticizers, antibacterials, preservatives, stimulants, and pharmaceuticals was used for a recovery study with three different bivalves types of high commercial interest such as mussel, oyster and cockle. QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) was used for the extraction and purification of the mixture of the purified extracts were injected in Orbitrap-Q-Exactive for identification and quantification of the priority contaminants. Twenty compounds including endocrine disrupting compounds, pesticides, and pharmaceuticals were extracted with recoveries ranging from 40.54 to 105.51 %. Quality parameters such as method detection and quantification limits, accuracy, and precision were studied. Besides, non-target analysis of other relevant contaminants that may be present in bivalves’ xenometabolome is ongoing.

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TH203 River ecosystem: an ecosystem approach to evaluate the ecological risk linked to the human health protection

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The anthropogenic pressure on river ecosystems can induce changes on their structural and functional characters as well as an increasing risk for human health. Over the last year, an ecosystem approach mainly based on multilevel bioindicators methods has been adopted for assessing the risk for human health. The samples processing plays a key role in the environmental analysis. Samplings were carried out in an area characterized by strong anthropogenic pressures (Tiber River Central Italy). The water samples were processed using the technique of filtration and concentration, as suggested within the European project µAQUA PFVII; at the same time, tests were carried out using raw water samples. The approach of this study is based on the following parameters: biological community (diatoms, macro invertebrates, macrophytes and fishes fauna); chemical–physical parameters, a set of ecotoxicological bioassays (Vibrio fischeri, Daphnia magna and Vicia faba); microbiological analysis (Salmonella spp, Staphylococcus spp, Clostridium spp. and Campylobacter uprjand virological analysis of invertebrates, HAV and HEV, Norovirus NoGi and NoGiII, Reovirus, Enterovirus: A, B and C, Adenovirus: ADV40 and ADV41. The results of this study showed that the pre-concentration of larger amount of water improves both the contaminants detection within aquatic ecosystems and the ecological risk evaluation. The ecotoxicological analysis is an important aspect in the integrated approach to evaluate the ecological risk linked to the human health protection. The integrated approach adopted has been a useful tool to describe the ecological status of surface waters and the related risk for human wellbeing, providing a complete and original vision of the qualitative state of the ecosystem. In conclusion these results highlighted the different levels of alteration and the potential need for the primary prevention and restoration, confirming that an ecosystem approach plays a key role in the ecological and human health risk assessments.

TH204 INTEGRATED EXPOSURE AND EFFECT DATABASE TOOLS TO SUPPORT HAZARD AND RISK ASSESSMENT


Use of available exposure and effect data are key to performing hazard and risk assessment of pollutants, and compiling different sources of data are often done in a case-by-case manner. Processing data is thus cumbersome and time consuming, whereas the availability of data is a large source of uncertainty in resulting assessments. The NIVA Risk Assessment database (NIVA RadbTM) has been developed as a module-based tool to facilitate the assembly, organisation, integration, visualisation and quality assurance of available exposure and effect information in order to speed up and perform consistent handling of relevant data. The NIVA RadbTM compile available experimental and predicted (computational) effect data that range from molecular and cellular responses characterising the mode of action (MOA), typically derived from high-throughput and high-content (in vitro) bioassays, to (apical) adverse data derived from whole organism bioassays of potential regulatory relevance. These effect data are assembled within the context of Adverse Outcome Pathways (AOPs) and can be linked to initial cellular responses referred to as molecular initiating events (MIE), to downstream key events (KE) at the cellular/organ level and finally to adverse outcomes (AO) at the individual or organism level. The resulting multi-level assemblies of data can be used in hazard assessment to identify the MOA of one or more stressors, to link molecular responses to higher organisation level effects and to identify potential stressors among large assemblages of pollution that can give rise to a given AO. The NIVA RadbTM also support risk assessment by calculating risk quotients (RQs) of single pollutants and mixtures of these on basis of exposure (typically measured or predicted environmental concentrations) and effect data (typically NOEC, ECx, PNEC or EQS values) and can identify risk drivers (most toxic chemicals), relevant toxic endpoints (i.e. MIE, KE and AO) and susceptible species for a given exposure scenario. Recent development in the integration of non-chemical stressors such as ionizing and non-ionizing radiation,Examples on uses on specific exposure scenarios will be presented to show the utility of the databases and the tools developed. Acknowledgements: RCN projects 221455-EDRISK (www.niva.no/edrisk), 268294 MixRisk (www.niva.no/mixrisk), 223268 CERAD (www.nmbu.no/en/services/centers/cerad), and EU-FP7 project SOLUTIONS (http://www.solutions-project.eu/project/).

TH205 Assessing exposure risk for marine bivalve Mytilus post by microplastic poly styrene particles

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BACKGROUND: Microplastics (MPs) are one of the most widespread emerging pollutants in aquatic ecosystems, posing impacts on marine organisms. However, little is explored for potential risks of environmentally relevant concentrations of MPs on bivalves. OBJECTIVE: In this study, the potential risk-based probabilistic model was used to characterize the potential hazards of marine bivalves in response to predicted environmental concentrations (PECs) of PS-MPs or MPs by quantifying exceedance risks (ERs) and hazard quotients (HQs) in five plastic-filled gyres.
RESULTS: We found that PNECs for inhibition of lysosomal membrane stability and phagocytic cells were 0.04 and 0.07 μg mL⁻¹, respectively, implicating that phagocytosis is a more sensitive endpoint for immune responses in bivalves. In addition, our results demonstrated that the North Pacific Ocean appeared to be the greatest risks among global oceans.

CONCLUSIONS: The strict thresholds estimated by applying a environmental risk assessment framework could be recommended as a criterion for environmental management of PS-MPs or MPs. Potential effects of PS-MPs/MPs on marine organisms at higher trophic levels should also be taken into consideration.

Keywords: Polystyrene microplastics; Bivalve; Environmental risk assessment; Predicted no-effect concentration; Predicted environmental concentration; Hazard quotient

TH207 Innovative Design of Nationwide Dutch Water Quality Monitoring
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According to the European Union Water Framework Directive (EU-WFD), chemical surface water quality is assessed by analysing the concentration of 45 priority compounds. However, the analysed chemicals are often absent and biological effects are thus caused by (un)known (mixtures of) compounds. Alternatively, water quality can be assessed by observing adverse effects of surface water on test organisms. Therefore, the present study aimed to innovate surface water quality assessment by applying an innovative design in a nationwide monitoring campaign in The Netherlands. To this purpose bioassays with two aquatic invertebrate species, Daphnia magna and Chironomus riparius, were employed and the performance of passive sampling techniques to include time integrated compound concentrations was explored. D. magna neonates and C. riparius larvae were exposed to surface water samples from 34 locations. Daphnids were additionally exposed to POCIS passive sampler extracts from 7 of these stations. For the daphnids, none of the surface water samples or passive sampler extracts caused significant mortality after 48h of exposure. In contrast, for the chironomids, three surface water samples caused significantly lower larval survival compared to the controls. The use of C. riparius bioassays thus allowed for differentiation between water quality of the sampling locations. Possible explanations for the observed chironomid mortality include insecticide sorption to the provided food, which may lead to increased exposure resulting in higher mortality. A possible culprit compound could be the neonicotinoid imidacloprid, which was detected at two locations with observed chironomid mortality.

Moreover, toxicity of imidacloprid to C. riparius is 500 times higher than to D. magna. This could thus explain the high mortality at these greenhouse locations. It is also known that the passive bioassays with multiple test species provides better insight into surface water quality, and is therefore a valuable addition to regular water quality monitoring.

TH208 Smart Monitoring: Application of innovative tools in nationwide water quality assessment
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The European Union Water Framework Directive requires member states to assess chemical water quality of surface waters by monitoring the presence of 45 priority substances. However, these substances are often banned and their concentration in surface waters is strongly decreased, frequently to levels below the limits of detection. Simultaneously, industries have switched to a myriad of alternative compounds that have serious impacts on water quality, most of which are not listed as priority substances. Consequently, a large portion of the observed toxic effects of surface waters cannot be attributed to compounds measured by the water authorities. Hence, there is an urgent need for an effect-based monitoring strategy that employs bioassays to identify environmental risks. Therefore, the aim of the present study was to implement innovative tools in a smart, integrated monitoring strategy, applied in a nationwide water quality assessment campaign in The Netherlands. The integrated monitoring strategy is built on passive sampling (PS) with a battery of bioassays to investigate ecotoxicological risk to aquatic biota. At 47 locations silicone rubbers and Polar Organic Chemical Integrative Samplers (POCIS) were exposed to surface water for 6 weeks. Alongside the PS a 7 day in-situ daphnid test was performed at all locations. Subsequent to field exposure, accumulated compounds were extracted from the PS after which a battery of 3 in vitro bioassays was performed: the distributed LLc44 gene eXpression (CALUX) bioassays was exposed to the re-dissolved extracts. The bioassay battery was selected such that it can identify the risk posed by a wide range of chemical pollutants and their transformation products, while simultaneously allowing for more targeted identification of groups of compounds that cause specific effects. Bioassay responses were compared to effect-based trigger values to identify potential ecotoxicological risks at the investigated locations. Subsequently, the SIMONI model was applied to rank sites based on ecotoxicological risk, rather than on the presence of priority compounds. It is concluded that the Smart Monitoring strategy allowed prioritization of sites based on ecotoxicological risks, identified the presence of hazardous compounds, regardless of being listed as priority compounds, but meanwhile could prevent costly chemical analysis at sites with low ecotoxicological risks.

TH209 Passive sampling in effect-based monitoring of two European rivers - exhalability of in vitro detected chemicals
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RECETOX EU commission Water Framework Directive considers employment of passive sampling and use of effect-based tools in the monitoring of aquatic pollution. A combination of both approaches was used for monitoring of two rivers differing significantly in pollution levels. The Bosna, moderate-sized river in Bosnia-Herzegovina, which is burdened by untreated wastewaters, was sampled by semipermeable passive sampling devices (SPMD) and POCIS samplers. The Danube, the largest river in the EU with relatively low pollution level, was sampled using a mobile dynamic passive sampling device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar chemicals (SPMD, SR) and adsorption sampler for the polar-ones (POCIS, ED). For the partitioning samplers, concentrations of collected chemicals in river water were derived using dissipation of performance reference compounds. For the adsorption samplers, the sampling rates were either taken from the literature (POCIS) or calculated from the first 6 days, after which the samples were detected both in adsorption (ED) and partitioning samplers (SR). The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQ,μg) of respective model compounds in water. The BEQ,μg levels were significantly higher in extracts from POCIS and ED samplers showing that the polar chemicals were responsible for most of the detected effects. Chemical analyses detected 103 and 209 chemicals in the Bosna and the Danube samples, respectively. The passive sampling allowed detection of chemicals at pg/L concentrations. The levels of chemicals with known biological potency for the studied endpoints were used for modeling of bioanalytical equivalents (BEQ,μg). The results of bioanalytical analysis and bioanalytical equivalents showed that the detected chemicals explained mostly a low fraction of the BEQ,μg. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQ,μg was comparable with the BEQ,μg levels. Both sampler combinations proved to be suitable for the detection of a large set of chemicals even at trace levels and for the complementary assessment of the biological potentials of the contaminant mixtures.

The SOLUTIONS project was supported by the 7th Framework Programme EU (FP7-ENV-2013) with grant agreement no. 603437.

TH210 Testing of realistic contaminant mixtures with the harpacticoid copepod species Nitocra spinipes using passive sampler extracts
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The use of passive sampling as a tool in environmental monitoring has gained wide acceptance within the past decades. More recently the possibilities of combining passive sampling and biotesting gained higher attention and researchers focus on reconstituting environmentally realistic contaminant mixtures in aquatic biostest systems. Equilibrium based samplers (e.g. silicone rubber sheets) can mostly be used as passive dosing devices in biotest systems without prior treatment but have the disadvantage that only one single concentration level can be tested. For innovative samplers (e.g. SpeckTM) an extraction is needed before sphering of biotest medium and the downside of this approach is that an extraction always changes the natural mixture composition due to compound specific partition coefficients. The advantage on the other hand is that the extraction of the samplers is well established, efficient and easy to combine with chemical analysis. Thus, even though this approach does not reconstitute the natural concentration profile quite reliably it allows us to test the ecological relevance of contaminant mixtures in terms of qualitative chemical composition. In the current study we extracted SpeckTM passive samplers that were deployed for 8 weeks in two Belgian harbours and one location next to one of the harbours to spike a 7-day larval development test with the harpacticoid copepod Nitocra spinipes following ISO 18220. In order to fractionate the compounds on the SpeckTM we followed two different procedures: a sequential and a parallel extraction approach using three solvents: acetoneitrile, ethyl acetate and dichlormethane. We exposed 80 larvae divided into 8 replicates in a fully randomized setup including controls and solvent controls to each of the SpeckTM extracts and counted larvae and copepodites after 7 days.
5, 6 and 7 days to calculate the larval development ratio. Results showed no statistically significant developmental effects for all tested extracts. The tested concentrations after solvent spiking in our test system were slightly below environmentally realistic contaminant concentration levels. Overall the larvae showed to be unaffected by the exposure to the SpeediSk™ extracts and we expect no direct effects of environmentally realistic contaminant mixtures on the development of *N. sippinax*.

**TH211**

**Passive dosing of polar and non-polar substances using Oasis HLB® - Pre-equilibration of media for transferring complex mixtures.**

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The passive dosing approach is currently focused on hydrophobic organic substances. Dosing phases such as polydimethylsiloxane (PDMS) silicone are suitable for this task, but also limit the approach to specifically this group of substances. However, metabolism, volatilization and sorption – particularly medium sorption – are also highly relevant for polar substances. Therefore, a requirement for the passive dosing of these substances also exists. To overcome the current limitations of silicone, the applicability of Oasis HLB for dosing polar and non-polar substances was tested in a neutral red assay. The findings show a high affinity of Oasis HLB by means of passive dosing. This could also be shown, that the adsorption based accumulation of the substances was reversible and – due to the high surface area and the wettable pores – relatively fast. This demonstrates its suitability for dosing a broad range of substances. With respect to combining equilibrium passive sampling and dosing for the recreation of field mixtures in toxicity test, pre-equilibration of the cell culture medium with Oasis HLB was successfully tested and compared with the direct passive dosing using Oasis HLB. On the one hand, the medium pre-equilibration approach enables one to control the role of temperature on the equilibrium state. On the other hand, due to the fact that the dosing phase is not directly introduced in the assay, maintaining of the test concentration over the test duration is diminished for some compounds.

In summary, the application of Oasis HLB as a passive dosing phase for environmental samples was successfully established and medium pre-equilibration for re-establishing field mixtures in an exposure medium was tested. This opens up the possibility of recreating broadcast mixtures sampled with Oasis HLB at natural ambient concentrations in toxicity and other tests.

**TH212**

**Passive dosing strategy for in vitro test systems: static concentration generator and continuous release**

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The ability to generate a true solution of a chemical substance at controlled concentrations is essential to generate meaningful aquatic toxicity information. This is especially relevant for fish toxicity testing, as it becomes highly challenging when dealing with hydrophobic (logK OW > 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their use is also expensive and may limit the application, especially in the case of hydrophobic substances. Historically, solvents were used to enhance the solubility, but their use is also expensive and may limit the application, especially in the case of hydrophobic substances. With the development of Oasis HLB, a solid-phase dosing agent with a high surface area and large pore volume becomes available. This substance can be used to generate solutions of truly dissolved substances at controlled and constant concentrations. The passive dosing approach is currently focused on hydrophobic organic substances. Dosing phases such as polydimethylsiloxane (PDMS) silicone are suitable for this task, but also limit the approach to specifically this group of substances. However, metabolism, volatilization and sorption – particularly medium sorption – are also highly relevant for polar substances. Therefore, a requirement for the passive dosing of these substances also exists. To overcome the current limitations of silicone, the applicability of Oasis HLB for dosing polar and non-polar substances was tested in a neutral red assay. The findings show a high affinity of Oasis HLB by means of passive dosing. This could also be shown, that the adsorption based accumulation of the substances was reversible and – due to the high surface area and the wettable pores – relatively fast. This demonstrates its suitability for dosing a broad range of substances. With respect to combining equilibrium passive sampling and dosing for the recreation of field mixtures in toxicity test, pre-equilibration of the cell culture medium with Oasis HLB was successfully tested and compared with the direct passive dosing using Oasis HLB. On the one hand, the medium pre-equilibration approach enables one to control the role of temperature on the equilibrium state. On the other hand, due to the fact that the dosing phase is not directly introduced in the assay, maintaining of the test concentration over the test duration is diminished for some compounds.

In summary, the application of Oasis HLB as a passive dosing phase for environmental samples was successfully established and medium pre-equilibration for re-establishing field mixtures in an exposure medium was tested. This opens up the possibility of recreating broadcast mixtures sampled with Oasis HLB at natural ambient concentrations in toxicity and other tests.

**TH214**

**Mixture Risk - Development of an effect-based chemical risk assessment strategy for sites contaminated with complex mixtures of organic and inorganic contaminants**

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Environmental contamination is usually comprised of a mixture of pollutants, each of them bearing the potential of causing different toxic responses towards humans and wildlife. Recent risk assessments still rely on chemical analyses only; however, such investigations do not provide information regarding the interactions between chemicals including their integrated toxicity. The limited knowledge of the risks associated with mixture toxicity is the starting point for this study, and is part of the EnForce project that aims to investigate the toxic responses of mixtures of pollutants and integrate those results into risk assessment. Partly, particularly per- and polyfluorinated alkyl substances (PFAS) are of major concern as they are extremely persistent and able to alter the toxicity of other pollutants. However, preliminary results showed that selected PFASs were not able to alter mechanism-specific toxic effects in vitro, while they decreased gene expression of the same mechanism using an *in vivo* model with zebrafish embryos. Moreover, so far no vertebrate based test system exists to quantify the toxic response of PFASs; thus, one objective of the project is to develop a bioanalytical tool for measurement of PFAS contamination. The toxic effects of environmental samples will be assessed by a combination of biotests and chemical analysis. For the identification of non-target pollutants, effect-directed analysis will be used consisting of fractionation, chemical analysis and biotests. In addition, the project aims to fill crucial gaps in the knowledge regarding molecular and cellular effects of PFASs. The results of the project will be used to perform comprehensive risk assessment of contaminated sites and will be communicated with industry partners and stakeholders.

**TH215**

**Analyzing chemical pollutants in water samples from an urban river and wastewater effluent in Hyderabad (India) and their ecoxicological effects using effect-directed analysis (EDA)**

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In India, surface water contamination in urban areas is a common issue. One major source of pollution may result from the discharge of treated and untreated wastewater, both domestic and industrial in receiving environments. This contamination composed of a complex mixture containing e.g. polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from industries or pharmaceuticals from residential waste may pose a risk not only to the environment but also human health. Previous studies have reported a strong presence of...
multi-resistant bacteria in the Musi River, which might be due to large pharmaceutical production located in Hyderabad. A cooperation between the Department of Ecosystem Analysis RWTH Aachen (ESA), the Helmholtz Centre for Environmental Research Leipzig (UFZ) and the Civil Engineering Department from the Indian Institute of Technology Madras (IITM) was formed to evaluate the water quality in the Musi River, an urban river in Hyderabad (Telangana state, India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOI: 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary, one from a wastewater treatment plant effluent and another sample from an industrial effluent. Currently, these samples are screened for their toxicity using the water extracts in a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater alga Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lytechye yeast estrogen screen. Further evaluation of the data and investigation on genotoxicity using the Ames assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and their ecotoxicological effects.

TH216 Ecotoxicological assessment of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays

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Ecotoxicological assessment of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater alga Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lytechye yeast estrogen screen. Further evaluation of the data and investigation on genotoxicity using the Ames assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and their ecotoxicological effects.

TH218 An ecotoxicological assessment of Lake Mondsee, Austria: a two year survey

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Lake Mondsee is a recreational area in Austria for both bathing and water activities/sports. Nearby exists a wastewater-treatment plant (WWTP) which can represent a point emission for the lake’s contamination. Accordingly, an ecotoxicological assessment of Lake Mondsee was carried out. Water (W) and sediment (S) samples were collected from Lake Mondsee and the reference site, Lake Irsee, on three different seasons: 1) summer 2015 (preliminary assessment of W and S samples’ toxicity), 2) spring 2016 (possible best-case scenario, since lake was frozen for the winter) and 3) summer 2016 (worst-case scenario, tourist activities peak). The WWTP inflow and outflow, plus pre-thickening (PS) and final effluent (TS) were collected. The toxicity assessment for summer 2015 was made by performing 48-h population growth (r) assays with the rotifer Brachionus calyciflorus (W samples) and the 15-min luminescence inhibition assay with the bacterium Vibrio fischeri (all samples). Regarding the W samples, results showed no luminescence inhibition for V. fischeri and average r inhibition rate (%) of B. calyciflorus was below 26%. The WWTP inflow samples presented high toxicity to B. calyciflorus (EC50 > 90%). Samples of S, PS and TS were extremely/toxic to V. fischeri. The samples collected during spring 2016 and summer 2016 were analysed through a battery of assays, with species belonging to different trophic levels. In addition to the two above mentioned tests: the 72-h growth inhibition test with Raphidiocelis subcapitata and the feeding inhibition test with Daphnia magna, tests were performed for the 6-day mortality and growth assessment with Heterocyclops incongruens for S, PS and TS samples. Regarding spring 2016, the average r inhibition rate (%) of B. calyciflorus was lower than 30% for most of the W samples and average did not surpass 12%. The Microtox® tests showed high toxicity only for all W, S, PS and TS samples. Samples collected in the summer 2016, showed similar results for the growth inhibition for R. subcapitata and the feeding inhibition test with D. magna, with values lower than 53% of B. calyciflorus and the 6-day mortality and growth assessment with H. incongruens showed some variation. No evidences of the influence of the WWTP present at lake Mondsee were retrieved, since W and S samples from both Lakes Mondsee and Irsee showed similar toxicity. Further chemical analysis is necessary to clarify the high toxicity observed in the sediments.

TH219 Availability of estrogens applied onto 96-well plates in the LYES

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The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on related topics. The latest focus study evaluated pesticides in sediments in catchments with intensive agricultural land use. For this purpose five small streams were sampled from the beginning of March to the end of August using half-day composite samples and an analytical method covering 213 active substances. The chemical analysis was complemented with several biological investigations. Measured concentrations of pesticides were used to determine the risk of pesticide mixtures. Using acute and chronic effect-based water quality criteria (QC), we calculated risk quotients (RQ). In a second step RQs of individual compounds were summed to provide separate mixture RQmix for plants, invertebrates and fish. In all the tested water bodies a chronic mixture risk with RQmix > 1 was determined. There was a chronic mixture risk at three sites for almost the entire sampling period. Consequently this resulted in no recovery time for aquatic organisms. An acute mixture risk was determined for four streams, with two of them showing high risks with RQmix greater than 10. In addition it was investigated to what extent the predicted mixture risk of herbicides was consistent with endpoints that are determined in the combined algae test. This test provides information on the inhibition of photosystem II (PS II) and algae growth. The resulting risk corresponded very well with the calculated mixture risk for PS II inhibitors. In one stream PS II inhibiting plant protection products dominated the mixture risks for plants. Both herbicides do not interfere with photosynthesis. For the detection of insecticide effects, invertebrate communities were sampled at all sites. Also an in situ biomonitoring with gammarids was carried out in the Eschelisbach, the site with particular high RQmix for invertebrates. Increased gammarid mortality was observed at the beginning of June 2015. This was in accordance with the high acute mixture risk, which during this period was dominated to more than 78% by the insecticide chlorpyrifos-methyl. The SPEARpesticide index also indicated a poor condition for invertebrates in the Eschelisbach. In this study, the biological investigations proved to be a valuable link between the chemical compound risk assessment and stream biology.
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Many in vitro bioassays are run on 96-well plates and typically, reference compounds, standards and samples are added to the wells of a plate using solvents (e.g. ethanol). These solvents are then evaporated, media with cells are added to the assigned wells. Reference compounds are generally evaluated along with the ethanol added. However, there is scant information on the kinetics of the redissolving behaviour of test substances on 96-well plates. Furthermore, a redissolving step can be circumvented by adding samples and standards directly to the assay, either dissolved in water or medium (or DMSO). In this study we compared the availability of four estrogenic compounds (E2, E1, E2 and BPA) on 96-well plates in the Lytice-based yeast estrogen screen assay (LYES; this test was recently adopted as an ISO standard). Two-fold dilution series of compounds were added directly to the wells via medium (aqueous; i.e. as suggested in the LYES ISO protocol) or using ethanol (ethanolic) which was evaporated before medium was added. We tested different redissolving times by shaking the plates, using shaking times between 0 to 120 min. After redissolving, medium was transferred to new wells for further testing (redissolved) and emptied wells were given fresh assay medium and yeast cells and were also tested (rest). We evaluated the recovery of test substances in “redissolved” and “rest” wells. Results revealed that, for all test substances: 1) less activity was observed after ethanolic application compared to aqueous application, while their relative potency towards the reference substance 17β-estradiol (E2) was retained; 2) Several studies have indicated that redissolving of BPA of the nominal activity appeared in the “redissolved” wells and ca. 50% of activity remained in the “rest” wells; and 3) shaking times beyond 10 min did not further enhance redissolving. The fact that less activity was observed following ethanolic application compared to aqueous application may be because: 1) a fraction of the compounds remain sorbed to the wells and never become available to the cells; 2) the compounds are not completely evaporated along with the ethanol added. To gather more information on these aspects – and to determine the actual concentrations in the two application methods – LC-MS/MS measurements of E2, E1, EE2 and BPA were performed in parallel to the bioassay. These data are currently being evaluated.

TH220 Mutagenic and ontogenetic responses in freshwater guppy Poecilia vivipara chronically exposed to waterborne sodium dodecyl sulfate (SDS)

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The deposition and persistence of some chemicals in aquatic environments is a constant threat to aquatic organisms. Sodium dodecyl sulfate (SDS) is a surfactant widely used as an emulsifier in household products and is constantly present in the environment. The main effects are related to the disruption of cell membranes and to the formation of micelles, which may be toxic to aquatic organisms. Under environmental conditions, SDS might change the ecolological behavior of aquatic organisms. In this study, the effects of chronic exposure to SDS on the behavior of guppy (Poecilia vivipara) were evaluated. For this purpose, guppies tickled in a flow-through system were exposed for 150 days to 0.1, 0.5, 0.6 1 mg/L of SDS. The behavior of the guppies was evaluated by the ethoxypropionate method (EPM). The EPM is a method that evaluates the behavior of aquatic organisms, in this case, guppies, in response to stress or environmental changes. In this experiment, the guppies were exposed to different concentrations of SDS, and their behavior was monitored throughout the experiment. The results showed that the guppies exposed to SDS had a reduced activity and mobility compared to the control group. This suggests that SDS has a negative impact on the behavior of guppies, which could have implications for the overall health and survival of these organisms in the aquatic environment.

TH221 Determination of Izmır Bay Pollution by Using Genetic Biomarkers in the Mussel (Mytilus galloprovincialis)

Vermeiren, Ecotop Centre Eawag-EPFL / Aquatic Ecotoxicology; D. Olbrich, Swiss Centre for Applied Ecotoxicology EAWAG - EPFL; L. Werner, Ecotop Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; E. Simon, Centre Ecotop / Aquatic Ecotoxicology

TH222 Bioassays stress the ecotoxicological differences between polymers and plastics additives in the marine environment

TH223 Effects of Potassium Bromate on the Embryological Development of the Sea Urchin Arbacia lixula (Linnaeus, 1758)

Vermeiren, Ecotop Centre Eawag-EPFL / Aquatic Ecotoxicology; D. Olbrich, Swiss Centre for Applied Ecotoxicology EAWAG - EPFL; L. Werner, Ecotop Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; E. Simon, Centre Ecotop / Aquatic Ecotoxicology

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TH267 Determination of Izmır Bay Pollution by Using Genetic Biomarkers in the Mussel (Mytilus galloprovincialis)
Effect of thermal stress on endocrine disruption in Daphnia magna
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Endocrine disrupting chemicals (EDCs) include various types of natural (17β-estradiol, estrone) and synthetic (nonylphenol, bisphenol-A) compounds presenting inhibition or mimicking of the reproductive action of endocrine system in vertebrates and humans. Recently, several studies reported that daphnid species which reproduce by parthenogenesis may generate male offspring in response to EDCs. In addition, it was demonstrated that variation of water temperature is able to change reproduction, growth, and survival of aquatic organisms and population number. This study aims to evaluate the effect of thermal stress on endocrine disrupting effect of EDCs using Daphnia magna. Short-term screening (STS) assay was performed to confirm the endocrine disruption effects using adult (10-17 days old) daphnids. Animals were exposed to two temperatures of 20 °C and 25 °C, and reproduction, growth, male production and survival rates were evaluated. This study can give a insight into the endocrine disrupting effects of EDCs on aquatic organisms under influence of thermal effluents discharged into streams and rivers.

TH225
Microplate Alga Growth-Inhibition Bioassay
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The development of new chemical compounds is a long and costly process that may span up to 10 years. However, the success rate of new chemical families has decreased exponentially in the last decades mainly due to compounds toxicity detected in later phases of the R&D process. The OECD publishes a series of guidelines to define the toxicity evaluation assays required for regulatory purposes. The 201 guidelines, in particular, describes the alga growth inhibition test for the evaluation of aquatic toxicity. Nevertheless, the procedure is tedious and time-consuming, so it’s not suited for high throughput screening of toxicity on early development phase. Given so, there is a need for new fast and cost-effective assays with an increased throughput to assess the aquatic toxicity of a compound in early phases of the development. In this work, we present a miniaturized version of the OECD 201 alga growth inhibition test. The miniaturized test is carried out in 96 well plates and the biomass measurement is performed on a plate reader. The methodology makes possible to test ten concentrations of a compound and a negative control on the same plate. The biomass measurement by fluorescence read produces a sensitive and reproducible measurement of alga concentration in an efficient manner, with a significant time and human labor reduction. The alga microplate assay was validated with environmentally relevant reference compounds (such as pesticides or flame retardants) and the resulting IC50 values were compared to the OECD 201 results.

Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy (P)

TH236
Applying Social-LCA and Social Hot Spot Analysis including a SDG Evaluation to Product Assessments with SEEBALANCE®
H. Saling, BASF SE / Sustainability Strategy; A. Alba Perez, T. Gruenewald, P. Koehlsch, BASF SE / CDS/S

Social criteria and objectives – such as education, health or working conditions – are becoming increasingly important which is why these factors are also addressed in most sustainability assessment methodologies. Nevertheless, the procedure is tedious and time-consuming, so it’s not suited for high throughput screening of toxicity on early development phase. Given so, there is a need for new fast and cost-effective assays with an increased throughput to assess the aquatic toxicity of a compound in early phases of the development. In this work, we present a miniaturized version of the OECD 201 alga growth inhibition test. The miniaturized test is carried out in 96 well plates and the biomass measurement is performed on a plate reader. The methodology makes possible to test ten concentrations of a compound and a negative control on the same plate. The biomass measurement by fluorescence read produces a sensitive and reproducible measurement of alga concentration in an efficient manner, with a significant time and human labor reduction. The alga microplate assay was validated with environmentally relevant reference compounds (such as pesticides or flame retardants) and the resulting IC50 values were compared to the OECD 201 results.

TH228
Sustainable Guar Initiative - an integrated approach of social and environmental LCA
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Sustainable Guar Initiative (SGI) is a three-year long integrated project aiming at developing sustainable guar production within the Bikaner district in Rajasthan, India. This desert district is one of the largest producers of guar and guar gum in India. SGI was set up by Solvay, L’Oreal, HiChem and the NGO TechnoServe, and is based on 4 themes: (1) Agronomy: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutral approaches and best practices in guar farming, along with tree plantation, (3) Social impact: gender approaches, nutrition, health & hygiene and (4) Market improvement: traceability, supply chain and market access. Guar gum is extracted from guar seed and can be used as such, or functionalized. It is for example used as a bio-based thickening agent in personal care products. To confirm and consolidate the relevance of the program and to identify potential improvement opportunities, an environmental and social Life Cycle Assessment (LCA) of SGI has been performed, comparing the guar production before and after the SGI. The social LCA has been conducted following already available guidelines, including UNEP-SETAC Guidelines for Social Life Cycle Assessment of Products and WBCSD Social Life Cycle Metrics for Chemical Products. Methodological developments have furthermore been undertaken in order to fully take into account the smallholders. The Master’s thesis “Integrating Smallholders within the Handbook for Product Social Impact Assessments” has been completed with some developments, related to: (1) Goal and scope: better identification of relevant stakeholders and social aspects, (2) Inventory: improvement of data quality among the social aspects, stakeholders or life cycle steps and (3) Performance assessment: common rating system enabling aggregation related to inventory from multiple sources. Besides environmental LCA, the poster will focus on social LCA. Methodological challenges encountered will be presented and solutions to tackle them will be detailed as long with other limits related to these new developments.

TH29
How the social pillar can be properly integrated into sustainability evaluation methodology? Evidence from bio-based products case study
P. Falcone, E. Imbert, A. Tani, V. Tartiu, P. Morone, Unitelma Sapientia University of Rome

Abstract
Along with environmental and economic assessment, social sustainability of the bioeconomy has become a growing challenge, with important efforts devoted to the market uptake of bio-based products. In recent years, social and socioeconomic aspects have progressively been included in both the discourses and sustainability analyses concerning the bioeconomy. Yet, when it comes to bio-based products the situation still lags behind (Siebert et al. 2017[1]), given that bio-based products involve longer and more complex value chains (Bell et al. 2014[2]) that make the assessment of social and socio-economic impacts extremely challenging. Furthermore, the success of a sustainable bioeconomy depends on stakeholders’ acceptance – especially consumers and manufacturers – leading to a growth in demand for such products. The choice of what is to be measured is the critical point in S-LCA and, by employing recognised participative techniques, the stakeholders’ involvement can be used to shape the final sustainability criteria and regulatory recommendations. Against this background, our study aims at investigating to the social impact of bio-based products, in particular the Sustainable Guar Initiative (SGI) case study. The poster will focus on bio-based products, by identifying and validating the main social impact categories pertaining to the bio-based products realm. In doing so, we employ a robust three-step methodological framework encompassing: impact categories identification, stakeholders mapping, and social impact categories validation. In order to operationalize the methodological framework, empirical data is gathered by means of in-depth literature review, stakeholders’ interviews, and focus groups. By providing empirical evidence on the social dimension, which incorporates different visions of the stakeholders involved in the bio-based value chains, our study paves the way for further developments concerning the integration of social assessments within bioeconomy context. Keywords: bio-based products, social assessment, stakeholders analysis, bio-economy, S-LCA, SGI, S-IAC, SIEBEL, Thránab D., (2017) Social life cycle assessment indicators and indicators to monitor the social implications of wood-based products. Journal of Cleaner Production, Available online 9 March 2017 [2] Bell, G., et al., (2014). IEA Bioenergy Task42 Bioengineering. Wageningen: IEA Bioenergy.
Improvements in environmental exposure assessment: development and application of tools industry sectors, regulatory agencies and international boundaries. Authors: S. Giardina, National Research Council (CNR); I. Santoro, Italian Ministry of the Environment; Land and Sea – General Directorate for environmental assessments and authorisations Maria Antonieta Orri – National Institute of Health - National Center for Chemical Substances Debora Romoli - Italian National Institute for Environmental Protection and Research.

TH232

Environmental Risk Assessment for some additives used in hydrocarbon extraction activities into the sea

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This approach allows to determine specific concentration limits eligible for seawater discharge of these additives. By applying this methodology we compared the Predicted No-Effect Concentration (PNEC) with the predicted environmental concentration (PEC) related to the release of the substance in the seawater. The work already concluded on Dietylene glycol showed that the condition of the additive was considered acceptable since the PNEC of 30 mg/l for constant/frequent release and 5900 mg/l for intermittent release. These limits have been included by the Ministry of Environment as a binding condition for granting the authorisation of discharge to the platform manager. Session: 3.12

Improvements in environmental exposure assessment: development and application of tools industry sectors, regulatory agencies and international boundaries.
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Oil and gas companies operating on the Norwegian Continental Shelf (NCS) are required to carry out environmental monitoring to obtain information on the actual and potential environmental impacts of their activities and to give authorities a better basis for regulation. Scientists, operators and regulators have worked jointly for the last two decades in this program, for developing, communicating and implementing knowledge, methods and tools to manage the offshore produced water discharges. A multidisciplinary approach (e.g. chemistry, biology, modelling and risk assessment) has been developed to monitor the discharge and reduce risk. Potential impacts from no-targeted chemicals have also been in the aim of this extensive monitoring program for anticipating negative effects at the ecosystem level. In 2015, new guidelines as result of assessment performed since 1995. The new requirements have been applied for the first time in the 2017 Water Column Monitoring program. This holistic approach shows a significant improvement in the scientific outcomes of the monitoring, in a cost-efficient way. The surveys included the use of species from various trophic levels and the analysis of both chemical and biological parameters. Three regions were selected: Tampen, Southern Norwegian Sea and Egersundbanken (reference area) and in addition the near platform effect (Staifjord A) was assessed. The study design included the use of a predictive discharge model (Dose-related Risk and Effect Assessment Model, DREAM). This model calculates the fate of the discharge in 4 dimensions (including time) to predict environmental concentrations, risk and effects. Biological and chemical data confirmed the accuracy of the study design and predicted effects. These interaction patterns are mechanisms that reduce the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. Among the potential applications, correlating dates and BBCH would help to: harmonize the application date selection to parameterize the application scheme implemented in the SWASH model, in order to predict pesticide’s loading in surface water due to drift, drainage and run-off, - provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process where a weight of evidence approach is envisaged.

TH235

DAPHNE: a supporting tool for pesticides risk assessors and stakeholders

A. Linguadoea, F. Galimberti, S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; L. Menaballi, ICPS International Centre for Pesticides and Health Risk Prevention; S. Ullucci, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health

DAPHNE (DAtes and PHenological Estimation) is a tool created to contribute supporting the Environmental Risk Assessment (ERA) of pesticides. The rationale behind its development is based on correlating crop phenological stages (BBCH) to specific dates for representative geographic areas is often a crucial step both for the exposure and (higher tier) effects assessment. However, currently there is no source of information clearly addressing this issue at the national, Zonal or EU scale. Data from a number of field efficacy trials were collected in a database that could realistically represent reference scenarios and typical Italian crops. These data included information on BBCH and related date, agronomic and pedoclimatic conditions. The dataset was primarily used to extrapolate BBCH vs date curves for selected crops. These interaction patterns are mechanisms that reduce the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. Among the potential applications, correlating dates and BBCH would help to: harmonize the application date selection to parameterize the application scheme implemented in the SWASH model, in order to predict pesticide’s loading in surface water due to drift, drainage and run-off, - provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process where a weight of evidence approach is envisaged.

TH236

The applicability of the assessment entity concept in the REACH registration of complex mixtures. A case study for fragrance substances

K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; G. Kreutzer, Givaudan SA; S. Kern, Givaudan Schweiz AG; M. Pacella, M. Torres Sanchez, Givaudan Suisse SA

The assessment entity (AE) concept was developed by ECHA together with industry representatives to facilitate the registration of complex products. The tool was introduced in IUCLID 6 and aims to assist users in documenting complex assessment cases in a transparent and systematic way. The assessment entities (AEs) may be imported in Chesar 3 for the purpose of exposure assessment. The relevance and applicability of the AE concept to multi constituent substances is illustrated by a fragrance ingredient case study. For the purpose of the worker and consumer exposure assessment, the traditional whole substance test battery was used. However, to assess environmental exposure and risk, a constituent block approach was used because the substance consists of components with different environmental fate properties (e.g. water solubility, log Kow, adsorption coefficient) and ecotoxicity profiles (e.g. acute EC50/LC50 values). The use of whole substance testing versus constituent data is explored. The adaptation of standard tests, such as the acute fish test, to the traditional whole substance test battery will be shown, using how the different HPLC partitioning characteristics of the components and the use of two analytical detection methods was exploited to obtain water solubility information for the individual blocks from a test performed on the whole substance. The case study also demonstrates the combined applicability of experimental data, QSAR and read-across in the assessment of the aquatic toxicity of the individual constituents and impurities in order to derive appropriate PNECs for each assessment entity.

TH237

Canada’s Approach to Determining Causes of Impact at Federal Contaminated Sites

M.H. Henning, D. Pelletier, Ramboll EH; M.T. Sorensen, Ramboll / Senior Science Advisor

Canada’s Federal Contaminated Sites Action Plan (FCSAP) was developed to reduce risks to human health and the environment from--and to--reduce the financial liabilities associated with--federal government activities since 1995. To support the development of ecological risk assessment (ERA) as a site management tool, a Focus Group developed guidance for conducting ERAs under FCSAP. One element of that guidance is a technical guidance module on conducting causality assessment. Causality assessment has the overarching goal of differentiating ecological impairment due to chemical stressors from natural variability and from impairment due to other stressors, such as biological and physical stressors. Costly remediation and litigation decisions often hinge on an assumption of causality. It is therefore essential that ERAs objectively examine all plausible causes of observed impairment and attempt to establish cause-and-effect relationships between stressors and responses. The FCSAP causality assessment framework is based on U.S. Environmental Protection Agency’s CADESS guidance, though it is simplified for ease of use and application. The framework and presentation close with an overview of case studies of the use of causality assessment at contaminated aquatic sites from the peer-reviewed literature.

TH238

Improving “man via the environment” exposure assessment for lead: a case study for blood lead levels with biomonitoring and recycling uses

S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; F. Verdonck, ARCHE; K. De Brouwere, VITO NV / Health; L. Geerts, VITO NV; J. Chowdhury, International Lead Association / Senior Scientist

Environment; L. Allen, S. Binks, International Lead Association

Current chemical safety assessments for metals under REACH typically include a generic, worst-case assessment where worst-case scenarios are assumed to result in maximum overexposure for all sensitive population groups. The assessment of the potential for human exposure to lead is relatively complex due to the multiple routes of exposure and the potential for accumulation in the body. A systematic approach is needed to identify the most likely causal pathway, plausibility, specificity, and predictive performance. Multiple lines of evidence on each candidate cause is then evaluated for both consistency and coherence of evidence. The presentation and the presentation close with an overview of case studies of the use of causality assessment at contaminated aquatic sites from the peer-reviewed literature.

TH239

Validation of the industrial Simple Treat model for a site with high lead release and recycling uses

J.C. Otto, M. Alter, A. Boehm, H. Eipel, I. Lemche, S. Pawlowski, BASF SE

Current chemical safety assessments for metals under REACH typically include a generic, worst-case assessment where worst-case scenarios are assumed to result in maximum overexposure for all sensitive population groups. The assessment of the potential for human exposure to lead is relatively complex due to the multiple routes of exposure and the potential for accumulation in the body. A systematic approach is needed to identify the most likely causal pathway, plausibility, specificity, and predictive performance. Multiple lines of evidence on each candidate cause is then evaluated for both consistency and coherence of evidence. The presentation and the presentation close with an overview of case studies of the use of causality assessment at contaminated aquatic sites from the peer-reviewed literature.

TH240

Validation of the industrial Simple Treat model for a site with high lead release and recycling uses

E. Lyng, International Research Institute of Stavanger; R.C. Sundt, Statoil

The surveys included the use of species from various trophic levels and the analysis of both chemical and biological parameters. Three regions were selected: Tampen, Southern Norwegian Sea and Egersundbanken (reference area) and in addition the near platform effect (Staifjord A) was assessed. The study design included the use of a predictive discharge model (Dose-related Risk and Effect Assessment Model, DREAM). This model calculates the fate of the discharge in 4 dimensions (including time) to predict environmental concentrations, risk and effects. Biological and chemical data confirmed the accuracy of the study design and predicted effects. These interaction patterns are mechanisms that reduce the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. Among the potential applications, correlating dates and BBCH would help to: harmonize the application date selection to parameterize the application scheme implemented in the SWASH model, in order to predict pesticide’s loading in surface water due to drift, drainage and run-off, - provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process where a weight of evidence approach is envisaged.

TH241

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The multimedia model Simple Treat is applied in the chemical legislation in Europe for decades and recently also in other legislations around the globe. It evaluates the distribution and elimination of chemicals by sewage treatment plants (STPs) in a municipal environment. It has been shown that the specific settings of industrial STPs differ largely compared to the standard settings of the municipal model of Simple Treat in terms of inter alia biological oxygen demand, hydraulic retention time, and biodegradation rate constants. The model was adapted to the chemical fate in industrial STPs (iTreat; Struys et al. 2016, Chemosphere 159, 619-627) but failed to show site specific validation due to lack of appropriate data. Therefore, the iTreat model was parametrized to the specific parameters of an industrial STP at a specific site. Time series of measured elimination of 22 substances in the waste water stream of this specific STP were gathered and compared to the calculated elimination rates. The biodegradation rate constant of substances was characterized as a sensitive parameter when predicting the elimination rate with either model. In detail, substances with low biodegradation rate constants (e.g. the rate constant of 0.1 h⁻¹) in the dataset show far more realistic elimination rates in the parametrized iTreat model than for the non-parametrized iTreat or the two municipal models. Compared to the municipal model of Simple Treat 3.1, the parametrized iTreat shows the two-fold higher elimination rates which reflect the measured elimination. The application of site specific degradation rate constants (derived from biodegradation tests with adapted activated sludge of the respective site) for the site-specific model of iTreat will also be discussed in this poster contribution. Taken together, the validation exercise was successful and the parametrized iTreat model is applicable to other substances being produced at this site where measured data is not available.

**TH240**

Combination of remote sensing and coarse statistical data for determination of precise spatial distribution of a pesticide load onto soils at a national scale

**V. Kodes**, Czech Hydrometeorological Institute / Section of water quality; L. Brodsky, Mapradix Ltd.; T. Herza, Hydrosoft Veleslavin Ltd.

Objective of the Study In order to calculate an annual pesticide load over a certain area, one needs detailed data on pesticides’ application that are hard to find in a real world. One way is to collect desired data from the farmers, but this is feasible just in relatively small areas. Due to missing detailed data, we computed more precise pesticide usage load using remotely sensed data (IRS AWIFS and multitemporal images Envisat MERIS, Landsat 7 – LEC, lately Landsat 8 – LDCM and Sentinel-2) together with a custom database of plant protection products were used. Crop cover to 12 classes) grids of 100 m cell size (later 14 classes, 25 m cell size) were derived from remote sensing images; the crops were linked to plant protection products (PPP) and active substances. Then redistribution of pesticide usage from districts to grid cells was carried out using established link between a crop, PPPs and respective active substances. Results The grid of pesticide usage on perennial crops is produced before the end of spring every year in order to provide data needed for monitoring of pesticides that starts regularly in April. The grid of pesticide usage on all the other crop classes is produced regularly in November. The results are published on WWW and annually updated in order to provide water managers with information necessary for a meaningful design of pesticide monitoring in the Czech Republic. Conclusion The product provides more detailed information on a spatial load of pesticides than other publicly available data on pesticide usage and it is very welcome by interested water managers. Further enhancements are planned in the future as new remote sensing sensors become available.

**TH241**

A Bayesian approach to estimate biodynamic model parameters: bioaccumulation of PCB 153 by the freshwater crustacean Gammarus fossarum.

**A. Ratier,** Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC Université Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / UMR EPOC LPTC; N. Delorme, L. Garnier, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Irstea / Water

Toxicokinetic models are used to describe how organisms bioaccumulate chemicals or other substances according to uptake and elimination processes. They provide a theoretical framework for understanding phenomena, testing hypotheses, and predicting some outputs of interest. In these models, the absorption process can result from dissolved or trophic routes. The elimination process includes excretion, biotransformation and dilution by growth. To date, models exist to describe the accumulation of persistent chemicals (in static systems) in various aquatic organisms. However, taking into account biotransformation remains problematic despite its potential importance. It is a key process that can limit the bioaccumulation of parent compounds while generating potentially hazardous metabolites. It varies considerably among species and contaminants. The aim of our study is to propose a Bayesian framework to estimate the parameters of a biodynamic model taking into account biotransformation, by considering simultaneously accumulation and depuration data. We illustrate our approach with the freshwater benthic invertebrate Gammarus fossarum exposed to 7 days to a sediment spiked with PCB153 and transferred to a clean media for 7 more days. The PCB153 concentrations in Gammarus fossarum increased from an initial concentration of 0.32 to 12.36 ng·g⁻¹ ww (weight wet) at the end of accumulation step. When gammarids were transferred into a clean media, the PCB153 concentration in organisms decreased to 6.41 ng·g⁻¹ ww at day 14. The bioaccumulation model assuming first-order kinetics was fitted to the data using Bayesian inference. The inference process quickly converged and thin posterior distributions were obtained for each parameter, meaning that data brough enough information to estimate precisely each parameter. The median model predictions and their 95% credible intervals showed a good fit of the model to the data.

**TH242**

Bioaccumulation and biotransformation of Hexabromocyclododecane (HBCD) by the freshwater crustacean Gammarus fossarum: a Bayesian approach to estimate biodynamic model parameters.

**A. Ratier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC Université Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / UMR EPOC LPTC; N. Delorme, L. Garnier, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Irstea / Water

The multimedia model Simple Treat is applied in the chemical legislation in Europe for decades and recently also in other legislations around the globe. It evaluates the distribution and elimination of chemicals by sewage treatment plants (STPs) in a municipal environment. It has been shown that the specific settings of industrial STPs differ largely compared to the standard settings of the municipal model of Simple Treat in terms of inter alia biological oxygen demand, hydraulic retention time, and biodegradation rate constants. The model was adapted to the chemical fate in industrial STPs (iTreat; Struys et al. 2016, Chemosphere 159, 619-627) but failed to show site specific validation due to lack of appropriate data. Therefore, the iTreat model was parametrized to the specific parameters of an industrial STP at a specific site. Time series of measured elimination of 22 substances in the waste water stream of this specific STP were gathered and compared to the calculated elimination rates. The biodegradation rate constant of substances was characterized as a sensitive parameter when predicting the elimination rate with either model. In detail, substances with low biodegradation rate constants (e.g. the rate constant of 0.1 h⁻¹) in the dataset show far more realistic elimination rates in the parametrized iTreat model than for the non-parametrized iTreat or the two municipal models. Compared to the municipal model of Simple Treat 3.1, the parametrized iTreat showed the two-fold higher elimination rates which reflect the measured elimination. The application of site specific degradation rate constants (derived from biodegradation tests with adapted activated sludge of the respective site) for the site-specific model of iTreat will also be discussed in this poster contribution. Taken together, the validation exercise was successful and the parametrized iTreat model is applicable to other substances being produced at this site where measured data is not available.
Our findings show that race/ethnicity, gender, and socioeconomic status can be statistically significant predictors of chemical exposure. More specifically, parabens, which are chemicals used in personal care products (PCPs), and 2,4- and 2,5-Dichlorophenol, which can be a products of photo-degradation of triclosan, a common antibacterial and antifungal agent, were observed to be elevated in African Americans when compared to White Americans. In addition, higher levels of parabens was observed in women, while men had showed higher concentrations of N,N-Diethyl-meta-toluamide (DEET). This could possibly be due to women using cosmetic PCPs more frequent and in larger amounts, and men using insect repellent slightly more frequently than women do. Finally, individuals of higher socioeconomic status had higher levels of benzophenone-3 (used in sunscreen products), parabens, and triclosan, which could possibly be explained by more accessibility to PCPs. In this study, we have identified inherent and demographic traits associated with elevated biomarker concentrations. We hypothesize that this is due to use patterns of consumer product, particularly PCPs. This could support research findings emphasizing the importance of near-field chemical exposures.

**TH244**

**Occupational exposure to flame retardants among Canadian e-waste dismantlers**

L.V. Nguyen, University of Toronto - Scarborough / Department of Physical and Environmental Sciences; V. H. Arrandale, Cancer Care Ontario; M. L. Diamond, University of Toronto / Department of Earth Sciences

The amount of e-waste produced globally is growing dramatically. National numbers suggest in 2010, 15.4 million tonnes were sold across Canada increased seven times in the period of 2002-2012 from 10,250 to 71,300 tonnes/y. One hazard associated with e-waste dismantling is flame retardants (FRs) which are added to electronic and electrical products to meet flammability standards. Little is known about exposure of workers to FRs in e-waste dismantling facilities in high-income countries such as Canada. Here, we have undertaken the first study to report on concentrations and profiles of selected FRs in indoor air and in the air in the dismantling facility in Southern Ontario, Canada, and to estimate occupational exposure of dismantlers at the facility to these FRs. Sampling was conducted daily over a total of five days in February 2017. Thirty-three dust samples were collected using vacuum cleaners and air samples were collected using polydimethylsiloxane (PDMS) air samplers (PDMS-PAEs) co-deployed with active low-volume air samplers (LV-AAS). A Micro-Orifice Uniform Deposition impactor (MOUDI) was used to obtain particle size distribution of air samples. Post-deployment, samples were extracted and analysed for 12 target FRs, including novel brominated flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs) and organophosphate esters (OPEs), using gas chromatography mass spectrometry (GC-MS). The most abundant FRs in air and dust samples were the novel anned BDE-209, accounting for ~70–98% of all target compounds. The median air concentrations of OPEs PBDEs ranged from 1930 ng/m³ to 2900 ng/m³. Preliminary estimates made using air concentrations measured here suggest that the total daily inhalation intake of all 12 FRs was ~17 µg/day FRs among e-waste dismantlers. Results for the MOUDI samples showed that triphenyl phosphate (TPhP) and other replacement FRs were much more abundant than polybrominated diphenyl ethers (PBDEs). Using a coated capillary, several on-line sample preconcentration techniques such as large volume sample stacking with an electroosmotic flow pump, field amplified sample injection (FASI) and counter flow (CF) were investigated. With CF, the sensitivity with absorbance detection is far below than needed. Using a coated capillary, several on-line sample preconcentration techniques such as large volume sample stacking with an electroosmotic flow pump, field amplified sample injection (FASI) and counter flow (CF) were therefore investigated. With CF-EKS using phosphate and N-(2-aminoethyl)-3-aminopropyltrimethoxysilane side chain, the detection of terminating electrolytes, standard samples of arsenite, arsenate, monomethylarsonic acid, and dimethylarsinate acid were preconcentrated from 6.300- to 45.000-fold. The limits of detection obtained with UV absorbance detection were 0.08–0.3 ppb As. For a spring water sample spiked with the four arsenic species, LODs of 2–9 ppb As were obtained, which are lower than the WHO guideline of 10 ppb total As.

**TH246**

**Sensitive Arsenic Speciation by Capillary Electrophoresis Using UV Absorbance Detection with On-Line Sample Preconcentration Techniques**

H. Lee, J. Kwon, Seoul National University; D. Chung, Seoul National University / Chemistry

The World Health Organization (WHO) guideline states that the total arsenic concentration in drinking water must not exceed 10 ppb. However, arsenic toxicity varies significantly, with inorganic arsenic species being more toxic than organic species. Arsenic speciation is therefore important for the evaluation of health risks from arsenic-contaminated drinking water. Capillary electrophoresis (CE) provides the necessary high performance separation for the determination of arsenic species and is a very sensitive technique using and terminating electrolytes, standard samples of arsenite, arsenate, monomethylarsonic acid, and dimethylarsinate acid were preconcentrated from 6.300- to 45.000-fold. The limits of detection obtained with UV absorbance detection were 0.08–0.3 ppb As. For a spring water sample spiked with the four arsenic species, LODs of 2–9 ppb As were obtained, which are lower than the WHO guideline of 10 ppb total As.

**TH248**

**Droplets deposition pattern from a prototype of a fixed spraying system in a sloping vineyard**

S. Ott, Italian National Research Council; G. Innernerbe, A. Schmid, C. Roschatt, Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE; M. to water, but it’s mid July with absorbance detection is far below than needed. In Italy quality vines are sometimes grown in small fields on steep slopes where spray-gun application of pesticides is used, a technique that is very costly and labor intensive. A possible alternative is the use of a fixed spraying system, and first researches are in progress. A fixed spraying system prototype was built in a vineyard at Laimburg Research Centre and a trial was performed with the aim of measuring the deposition pattern of droplets on the row and between rows with water sensitive papers, also in comparison with a precise low-drift air-spray blaster. Results show that a fixed spraying system has the potential to apply plant protection products without generating drift problems, with a performance similar to a low-drift sprayer, becoming an opportunity for vineyards on very steep slopes.
µg/L. Here an existing continuous flow analysis (CFA) method was selected using a system with a special cuvette installation allowing a higher sensitivity. The protocol was validated and accredited according to standard ISO/IEC 17025. With this system an LOQ of 0.15 µg/L can be reached under optimal conditions while an LOQ of about 0.3 µg/L is achieved during routine operation. Previous to field testing it was verified that samples can be stabilized for at least 24 h by adjusting the pH of samples from 12 to 3, and storing in the dark at 4°C. Samples spiked with low concentrations of a cyanoanilide standard were used as positive controls. The field validation results were satisfactory, confirming that the protocol is fit for purpose. Finally, samples from several sites of a small stream with low anthropogenic influences (River Lenne) were taken and analyzed. Free cyanide concentrations of up to 0.4 µg/L were detected. There were significant differences in free cyanide concentrations between sites, with levels including 8 µg/L. Detection of cyanide (LOD, 1/3 of the LOQ), and downstream sampling points where free cyanide concentrations were at least 50% higher, possibly due to degraded plant biomass in the water. This first measurements revealed that background concentrations of free cyanide in the tested surface waters can be below the proposed EQS of 0.5 µg/L. However, the analysis of further parameters (e.g. geographical regions, seasonality) is necessary to create a reliable database on the range of free cyanide background levels as basis for EQS implementation.

TH249

Application of equilibrium and kinetic passive sampling method to quantify integrative chemical profile in a small river and the outflow of WTW Yprotet, H. KW with prof. Isabelle Sauleau; Safir Mougoue Meyer, E. Finufrocken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaefeer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

Monitoring water quality is challenging as most of organic contaminants present at trace levels and chemical profile is fluctuating. Current legislative requirement of water monitoring is in conflict with the limited budget available for the monitoring of priority substances, which is efficient approach in water management. However, the capturing variable contaminant level is also critical for eco-toxicological risk assessment. The present study reports on how to exploit equilibrium and kinetic passive sampler in parallel and evaluate dynamic chemical profile in order to satisfy the standards with requirements and environmental risk assessment. Furthermore, partitioning kinetics of a range of organic contaminants toward each passive sampler type were discussed. The equilibrium sampler tends to be biased toward present chemical profile, which is rather close to instant sample, whereas kinetic sampler provides a time-weighted average concentration (C_{TWA}) over the full sampling period. PDMs sheets with two different thicknesses (76 and 205 µm), as an equilibrium passive sampler, were deployed without the application of performance reference compounds. From the concentration ratio from two PDMs sheets, true in situ concentration (C_{true}) of a range of target compounds was determined. In parallel, two types of polar organic chemical integrative sampler (POCIS) were selected as a kinetic passive sampler. The one is typical POCIS with Oasis HLB® sandwiched between polyethersulfone membranes and the other is modified POCIS with Oasis HLB® and polytetrafluoroethylene membrane to reduce membrane sorption artefact, which has been often discussed as one of limitation of POCIS. River Ellbach and the outflow of wastewater treatment plant located south-western Germany were selected as sampling sites and duplicate passive samplers were deployed for two weeks. After sampler recovery, targeted analysis via LC-MS/MS analysis was followed. Based on earlier results, both sampler types performed well and 19 contaminants were detected in total including 8 priority substances in EU WFD. C_{TWA} values can be used as a representative values for the comparison with environmental quality standards and C_{true} values can be regarded as variable exposure level. Complementary use of kinetic and equilibrium passive sampler enabled us to comprehensively identify multiple aspect of water quality. Studies on coupling passive sampling with passive dosing mode for risk assessment are ongoing.

TH250

Improvement of relationship between water pesticide contamination and land used at a large scale using the Polar Organic Chemical Integrative Sampler (POCIS). G. Reinhard, K. Mazzella, Irstea Bordeaux / UR EABX; M. Saut, J. Rebillard, AEAG Toulouse; N. Mazzella, Irstea Bordeaux / UR EABX

The sampling of micropollutants is a challenge due to their weak concentrations and their temporal variability. These last years, passive samplers have been developed with the advantage to improve the temporal representativeness by measuring “Time Weighted Average (TWA) concentrations”. For the passive sampling of moderately hydrophilic organic contaminants, the Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clean gels let in contact for 30 minutes. The concentration in each gel disk was determined over the time, allowing the calculation of diffusion coefficients according to Fick’s second law. Diffusion coefficients obtained with this method are congruent with those found in literature. Then obtained with the diffusion cell method are similar than those obtained by slice stacking except for ionic compounds, which also exhibited lower affinity with gels than water, in comparison to neutral compounds. The second step consisted in membrane selection, necessary to protect diffusive gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 and 0.2 µm). Finally, to evaluate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.

TH251

Development and calibration of o-DGT for pesticides, hormones and pharmaceuticals. B. Boutry, E. Fünfrocken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaefeer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

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TH252

Evaluation of Translocation of [14C]Radiolabeled Plant Protection Product in Tomato Fully Grown in a Greenhouse. S. Freedlander, Smithers Viscentis, LLC / Environmental Fate and Metabolism; S. RAO, Gowan Company / Regulatory; K. Malekani, S. Kang, Smithers Viscentis / Environmental Fate and Metabolism

Once applied to a plant, pesticide residues have the potential to move to other plant tissues (via a phyllotactic pathway) and to reach sensitive sites (i.e. seeds and consumers of the plant tissues). The objective of this study was to evaluate the translocation of a pesticide through phloem and xylem to various tomato tissues (flower, leave, stem, and root) when applied to leaves and soil. A suspension concentration (SC) formulation was prepared with 14C radiolabeled active ingredient. The study was conducted with three groups of tomato plants. Group 1 and 3 were cultivated in a greenhouse and plants were exposed to formulation containing [14C]active ingredient by foliar application and soil drench, respectively, in a single application at a rate of 0.50 kg a.i./ha. Leaves, stems, and flowers were harvested at 1, 2, 4, 6, and 8 weeks after application (WAP) and root tissue was harvested at 8 WAP. At each sampling interval, the collected tissues were analyzed for total radioactive residue (TRR) by combustion analysis and autoradiography by phosphor-imager analysis. The TRR in all tissue types from the soil drench group was higher than in corresponding tissues from the foliar application group. The autoradiographs of all tissue types from the soil drench group were comparatively darker than in corresponding tissues from the foliar
application group. Although both basipetal movement (downward from leaf application site) via phloem and acropetal movement (upward from both leaf and root application sites) via xylem were observed, results indicate the movement of radioactive residues is much faster through xylem. Select tissue samples were extracted and analyzed by HPLC-RAM, which shows that the majority of translocated radioactive residues by phloem was metabolites of the active ingredient. In a comparative study of translocation under a conventional plant mass spectrometry study can provide valuable information to further assess the potential effects of plant protection products on pollinating insects.

**TH253**

**An Examination of Microbial Biomass in Sediments and the Impact of Seasonal Variation**

K. Malekani, Smithers Viscent / Environmental Fate and Metabolism; S.P. McLaughlin, Smithers Viscent / Department of Environmental Fate; K. Campbell, Smithers Viscent / Environmental Fate Metabolism

Microbial biomass is an important measure of the health and viability of a sediment just as it is for soils. It is also a parameter used to assess viability of the seetoxicoecological Studies. A Lemmens Institute and Institute Meganol Chemist in sediments is typically determined by fumigation/extraction procedure prior to test initiation (post-handling/pretreatment), near test initiation and near test termination. The current presentation will focus on the initial microbial biomass as an indication of health and viability of sediments at the time of their collection. A collection of initial sediment microbial biomass values has been summarized and presented based on their time of collection during the year. An example of a sediment (Taunton) and one sandy sediment (Weweantic) collected during all four seasons, over a two-year period produced microbial biomass values (expressed as % OC) shown below. 2016 Taunton Weweantic 2017 Taunton Weweantic Winter 0.47 0.11 Winter 0.81 0.05 Spring 0.32 1.1 Spring 0.76 0.82 Summer 0.63 0.28 Summer 0.51 0.41 Fall 0.40 0.22 Fall 0.60 0.71 Late summer Additional biomass results will be presented, discussed and correlated to other sediment parameters, including texture, pH, and % OC. Conclusions from several sediments used in recent years will be extrapolated from trends in the data set concerning seasonality, environmental conditions and sediment characteristics.

**TH254**

**Use of scanning electron microscope (SEM) in evaluation of hypopharyngeal glands development in Honey bees (Apis mellifera L.)**


The hypopharyngeal glands (HPG) of Honeybees consist of many acini connected with collecting duct, arranged in the form of long paired cords lying on the both sides of the head. They played important role in maintaining healthy colonies i.e. through production of “milk” containing proteinic substances to feed larvae and queen. The aim of this study was to check the possibility of using scanning electron microscope (SEM) to evaluate the development of hypopharyngeal glands of bees, considering reliability, work-, time-consuming and cost-effectiveness of the method, including collecting of material. The study was conducted on Honey bees (Apis mellifera L.) subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSA Journal 2013;11(7):3295). Animals were treated with different chemicals in 4 to 5 concentrations. The left HPG were obtained from 5 bees per test item (in the highest concentration, which did not cause mortality below 50%), and the negative control. The specimens were fixed in 2.5 % paraformaldehyde in phosphate buffer, then postfixed in 1 % OsO4 and dehydrated with grades series of ethyl alcohol followed by acetone. Next specimens were critical-dried (CPDS, Critical Point Drying System), then coated with gold particles prior to observation in JEOL JSM-6390LV. The images and linear measurements (small and big axis of symmetry) from ten acini as well as number of acini per 1 mm2 were taken from each samples. The analysis of the results showed decreases and increases of acini and their number per 1 mm2, depending on the test item, however, these differences were not always statistically significant. It turns-out, that images were very valuable, allowing visual comparison of acini. Data obtained from the studies indicate that SEM can be useful tool for evaluation of hypopharyngeal glands development of Honey bees.

**TH255**

**Comparison of International Quality Assurance and Quality Control Standards for High Resolution Mass Spectrometry Dioxin Analysis**

D. Thal, E. Ogbern, Environmental Standards Inc; R. Vitale, Environmental Standards; D. Blye, Environmental Standards

The analysis of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) in environmental media, foods and tissues by high resolution gas chromatography-high resolution mass spectrometry (HRMS) is frequently used as the reference methodology against which other candidate analytical approaches and measurement procedures are compared. Official methods for this technology, ensuring internationally recognized standards for recovery correction have been established in the EU, the USA, Japan and other nations for decades and international standards for such methods have been established by ISO (Standards 13914 and 18073, for example). To identify achievable best practices and to understand differences in precision, accuracy and quantitative certainty for data produced from wide-ranging sources, an examination of the requirements of these methods was conducted. A review identifying critical differences and areas of agreement with regard to qualitative criteria, precision and accuracy will be presented, with perspectives on the impact differences may have on data uses by researchers conducting analyses under different protocols.

**TH256**

**New Mass Spectrometry Techniques for the Measurement of Persistent Organic Pollutants.**

P. D. Jones, University of Saskatchewan / School of Environment and Sustainability; J. Giery, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre

Recent development of new advanced Mass spectrometry and instrumentation has increased the amount and quality of analytical information that can be obtained from samples. In particular, dramatic increases in mass resolution have made possible unequivocal identification of contaminants even in complex matrices and mixtures. In the area of POPs analyses of PCDD/Fs and PCBs are of concern due to small concentrations that need to be quantified and the presence of a wide range of structurally and chemically related compounds. Development of a GC/QOrbitrap system brings levels of mass resolution not previously available for analysis of POPs by GC chromatography coupled with ultra-high resolution mass spectrometry (GC-UCRMS). Here we report use of GC-UCRMS for identification and quantification of PCDD/Fs and PCBs. The methods developed are based on standard US-EPA methods (Methods 1613 and 1680) but are enhanced by use of new capabilities provided by image current detection and high mass resolution (>100,000 FWHM). Robustness of the PCDF/AF analyses were demonstrated by excellent calibration characteristics and ability to detect all 2,3,7,8-substituted congeners even in an extract of used motor oil. Reanalysis of fish tissues previously analyzed by a magnetic sector instrument demonstrate accurate identification of contaminants and quantifications and provide validation to the method. Analyses were also conducted to determine the potential for a ‘multiplex’ analysis of various POPs where the resolving power (>120,000 FWHM) of the MS system was able to eliminate potential interferences from a variety of ‘non-target’ organochlorines. These multiplexed analyses significantly reduce the time and cost of sample extract preparation and clean-up. In addition, the relatively simple auto-tuning and mass calibration algorithms available for the advanced mass spectrometry systems greatly simplify these otherwise challenging analyses.

**TH257**

**Influence of water temperature and salinity on impact of Hazardous and Noxious Substances (HNS) in the marine environment**

M. vannoni, D. Doran, E. Ogburn, Environmental Standards Inc; R. Vitale, Environmental Standards Inc; R. Sheahan, Cefas

It is recognised that Hazardous and Noxious Substances (HNS) transported at sea present a broad range of potential marine spill scenarios due to wide range of fate and effects of the many types transported in bulk through national and international waters. To improve preparedness of response and to provide better advice during marine incidents there is a need to improve our knowledge of the marine hazard/risk associated with the highest priority chemicals. Harbours and ports are typically located in transitional and coastal waters and so ship traffic is more concentrated around these areas and so potential collisions are more likely. These areas are characterised by a range of salinity from 10 - 20 ppt within estuaries up to 34 ppt in coastal and offshore waters. Similarly, seawater temperatures vary significantly with seasonal temperature variability. It is recognised that due to the presence of cities and port and harbour facilities have higher density of traffic areas that due to the presence of cities and port and harbour facilities have higher density of traffic.
Acetylcholinesterase inhibition in muscle tissue of Limanda limanda. I. Uzyczak, Centre for Environment, Fisheries and Aquaculture Science (Cefas) / Environmental and Animal Health

Acetylcholinesterase inhibition (AChE) has been used as a biomarker of the effects of organophosphate and carbamate compounds. AChE is present in most animals and is responsible for the rapid hydrolytic degradation of the neurotransmitter acetylcholine (Ach). The concentration of AChE in muscle is dependent on the rate of hydrolysis of Ach. AChE is regulated by the nervous system, which regulates the concentration of Ach. When AChE is inactivated by an organophosphorus or carbamate ester, the enzyme is no longer able to hydrolyse Ach and the concentration of Ach remains high. Continuous stimulation of the muscle or nerve then occurs, resulting in tetany and eventually paralysis and death. The ICES/IOC International workshop on Biological Effects of Contaminants, that took place in Bremerhaven, Germany during March 1990, provided on opportunity to test AChE inhibition as an index of marine contamination. An official ICES Technique in Marine Environmental Sciences (TIMES No.22 Biological effects of contaminants: Cholinesterase inhibition by organophosphate and carbamate compounds) is available and recommended for contaminant monitoring programmes in the marine environment. This method was published to improve and standardise the comparability between results from different laboratories and/or countries. However, the method has not been updated since 1998 and does not provide enough details on different marine species, preparation and handling of samples or storage conditions. The search continues for new monitoring tools, improvement and harmonisation of existing methods, which may be used as specific markers for contaminant effects on the marine environment. For this purpose we are pursuing harmonizing approaches and resource sharing between assessment phases. The marine issue of Limanda limanda collected from sampling areas in the North Sea as a part of the Clean Seas Environmental Monitoring Programme (CSEMP) in the UK. The methods showed different results but verified fundamental requirements in all the procedures such as storage conditions, age of the samples or temperature dependence. More work needs to be done to standardise different approaches and come up with a more defined and accurate guideline. This should help to obtain precise, consistent and comparable results across the national and international laboratories and therefore provide a real evaluation of the status of the marine environment.

Environmental exposure to surface water for analogous exposure path. A reflection on the matter for biocides, human and veterinary medicines.

A. Haro-Castuera, R. Carapeto García, Spanish Medicines Agency / Veterinary medicines; G. Cortés Ruiz, C. Rubio Montejano, Spanish Medicines Agency / Department of Veterinary Medicines

Our mission has happened for one active substance the chain of events affecting the Environment follows its path. But how we study them depends upon the approach, dictated by legislative frames, subsequent guidance and, eventually, inertia and tradition. One remarkable example is the case of insecticides. While sharing the same active substance, different products authorized under different regulation can be applied differently. Then, to be marketed, scientific evidence of safety is mandatory. For the same reason, legal safety frameworks. The principle issue for the Environment share some principles making emphasis in different areas. Here, we will review emission paths and key risk elements as a thought starter pursuing harmonizing approaches and resource sharing between assessment schemes.

Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (P)

Using microarthropod community assays in metal mixture testing

J. Renand, CEF - Centre for Functional Ecology; T. Natal da Luz, University of Coimbra / Department of Life Sciences; University of Coimbra; S. Siciliano, University of Saskatchewan / Department of Soil Science; J. Sousa, University of Coimbra / Department of Life Sciences

Due to anthropogenic activities metal contaminated sites are a constant environmental concern and because of the persistence of these metal elements, will continue to be a pressing issue for many years to come. In terms of legislation and environmental risk assessment, much effort has been undertaken to understand the effects of metals and, more recently, the effects of metal mixtures. However, most legislation still focuses on single metal elements, disregarding mixtures. Similarly, research has been predominantly focused on single metals while mixture studies have mostly focused on binary and tertiary mixtures to determine metal interactions and bioavailability. It was the addition of mixtures to the most commonly accepted model and that considered in legislation. These studies provide valuable information on the metal mixtures but are performed with few standard test species and use mixture ratios optimized for the goal of modelling mixture interactions, which many times lack environmental relevance. In this presentation we take a different approach and test three complex five metal element mixture ratios (Pb, Cu, Ni, Zn, Co) using a natural soil microarthropod community. These metal mixture ratios were selected base on environmental and legislative relevancy, two ratios

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produced from guideline values (Canadian soil quality guideline and EU REACH PNEC values) and a ratio based on the average concentrations in a contaminated site (Sudbury) for each metal. Each mixture was tested with 11 doses in toxic units estimated from Folsomia candida reproduction EC50 for each metal in the mixture. The community results from this experiment were transformed to similarity matrices using the Bray-Curtis coefficient and used to calculate dose response curves. This approach assumes that community changes are promoted by increasing metal contamination. These community dose response curves allowed the estimation of microarthropod community EC values, which provide valuable insight on the adequacy of current guideline values and in developing site-specific risk assessments and remedial goals with community endpoints. Produced EC values from this simplified community experiment are currently under validation in a terrestrial model ecosystem experiment, for these same mixtures.

TH264
Alteration of stress-related and thyroid hormone related genes in zebrafish larvae after the administrations of lead acetate, and mixtures of lead acetate and BDE-209
K. Chan, The Chinese University of Hong Kong / Life Sciences; C. Leung, The Chinese University of Hong Kong / School of Life Sciences; Z. Zhou, J. Yang, The Chinese University of Hong Kong / School of Life Science
The expression profile of oxidative stress-related genes (sod1, sod2, sod3a, cc, cat, gr, gst), and thyroid-related genes (tr, trf, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae. A comparison of both individual exposure and co-exposure, such as lead acetate and BDE-209 on thyroid hormone metabolism and oxidative stress balance. Transcripts of gr and gst were induced upon both individual exposures and co-exposure, suggesting that both lead and its metabolites could affect thyroid and oxidative stress balance. No synergistic effects of the two chemicals at short time (48 hr) exposure to induce oxidative stress, while the possibility of these two chemicals acting synergistically to alter the gene transcription at later time points should not be ruled out.

TH265
Assessment of the toxic interaction of lanthanides on aquatic organisms
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The relevance of lanthanides (LNs), in agricultural, industrial and, especially in high-tech applications has increased in the last decades. As consequence, more LNs are expected to enter into the environment and accumulate in the ecosystem. Although no great accumulations have so far been recorded, alterations in the LNs natural cycle of lanthanides with lead, mercury, and copper and the potential to interact were evidenced in the experiment. The expression profile of tr, trf, dio1, dio2, nis, sod1-s1, sod1-s2, sod1-s3, ug1ab, ug2a1, and the above oxidative stress-related genes, was also studied to unveil the impacts of co-exposure of lead acetate and BDE-209 on thyroid hormone metabolism and oxidative stress balance. Transcripts of gr and gst were induced upon both individual exposures and co-exposure, suggesting that both lead and its metabolites could affect thyroid and oxidative stress balance. No synergistic effects of the two chemicals at short time (48 hr) exposure to induce oxidative stress, while the possibility of these two chemicals acting synergistically to alter the gene transcription at later time points should not be ruled out.

TH266
Prediction of the chemical and biological effects of tertiary metal mixture (Ni, Cu, Cd) to aquatic plant, Lemma gibba under different dissolved organic carbon concentrations
S. Martinez, CONICET PRIET / PRIET; Y. Gopalapillai, Environment and Climate Change Canada; M. Saen, PRIET CONICET, National University of Luján; B. Hale, School of Environmental Sciences, University of Guelph; W. D. Di Martino, CONICET-PRIET / PRIET
Toxic effects of single metals on aquatic environments are well established. In nature, organisms are exposed to a mixture of them at different bioavailability conditions. However, this situation is not always well studied. Here Lemma gibba was exposed to Ni, Cd and Zn individually and as ternary mixtures. The influence in the uptake and toxicity of dissolved organic carbon (DOC) as an environmental light was studied. Two sets of tests were performed: 0.5 mg/L and 10 mg/L of DOC. The metal concentrations at the mixture tests were chosen by an incomplete factorial design, resulting in controls plus 20 tests cases. Fron number inhibition (%FNI) and root growth inhibition (%RGI) were calculated at the end of 7-days tests. Determinations of internal dose [Mint] and external dose [Mem] were also conducted for all chronic tests. Single metal toxicity thresholds were obtained for the three metals, resulting %RGI a more sensitive endpoint than %FNI in all cases. For the test with 0.5 mg DOC/L, Cd presented the higher toxicity, based on %RGI when concentration expressed as Mint (IC25r = 20.8 µg/L) being 6 times more toxic than Ni and 30 times than Zn. When concentration expressed as Mint/Cd was also the more toxic metal (IC25r = 76.67 µg/g dry weight) being 10 times more toxic than Ni and 26 times than Zn. For the test with 10 mg DOC/L, Ni was the most toxic when dose expressed as Mext, but Cd when expressed as Mem. At the end of assays, for both DOC concentrations, [Cd] was the appropriate higher in the single metal exposure compared to the mixtures. For the mixtures exposures, the %RGI responses ranged from 17 to 94 % in the lower DOC concentration test and from 15 to 97 % in the higher. Concentration addition (CA) of 5% (Sol), and Mem was isolated through steam-sting and was used to fit the observed metal mixture toxicity data to either Mem or Mext. The concentrations of the three metals in mixture expected to result in 50% RGI or FNI were calculated by solving the regression for Cd while holding the concentrations of Ni and Zn constant for each of the 20 cases. To determine whether CA was the appropriate model for the mixtures’ toxicity, the combinations of concentrations were used to calculate the ‘sum of toxic units’ (CTU). Deviations from CA approach were observed as relative results according with the metal under analysis.

TH267
ISOLATION AND CHARACTERIZATION OF HEAVY METAL RESISTANT BACTERIA FROM SOIL SAMPLES FROM MAMBILLA ARTISANAL MINING SITE, NIGERIA
O. Otoito, federal University Wukari / Department of Biochemistry; T. Silas, federal University Wukari; A. Martins, S. Asemave, federal University Wukari / Biochemistry
Incidence of soil contamination by heavy metals is widely increasing with the spread of industries. Antibiotic resistant Staphylococcus aureus or Pseudomonas aeruginosa which are found in the Mambilla plateau has been on the increase in recent years. Therefore, the present study was aimed at characterizing and determining resistance to lead, mercury and copper by selected bacterial strains isolated in soil from Mambilla Plateau artisanal mine and to explore their bioremediation capacity. Bacteria were isolated from soil samples obtained from different locations at the Mambilla artisanal mining site, Nigeria. Five (5) bacterial isolates and M. aureus were isolated through gram-stain analysis and were used to test their antimicrobial activity. Biochemical tests and they were identified as Staphylococcus aureus, Escherichia coli, Bacillus sp, Enterobacter aerogenes and Pseudomonas aeruginosa. Out of the five (5) bacterial isolates, three (Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli) were selected and grown on nutrient agar plates incorporated with heavy metals namely Lead, Mercury, and Copper. These isolates showed multiple resistance to antibiotics and heavy metals. Staphylococcus aureus exhibited maximum tolerance to Lead, Mercury and Copper at concentrations of 0.15, 0.25 and 0.10/100ml respectively. Pseudomonas aeruginosa showed maximum tolerance to lead, Mercury and Copper at concentrations of 0.20, 0.20 and 0.10/100ml. Escherichia coli exhibited maximum tolerance to Lead, Mercury and Copper at concentrations of 0.25, 0.15 and 0.15/100ml respectively. The isolates also exhibited high level of resistance to these metals with MICs ranging from 0.15-0.30/100ml. Copper was the most toxic metal with MIC of 0.15/100ml while Mercury was the least toxic with MIC of 0.30/100ml. Antibiotic sensitivity test showed that the 3 bacterial isolates were multi-antibiotic resistant. The results of the present study showed that Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli are capable of bioremediation of heavy metals contaminated environments. However, some species of these bacteria are opportunistic pathogens.

TH268
The exceptions to the rule? Metal bioaccumulation in macroinvertebrates from a forested metal-polluted site in the Blue Ridge Mountains, Virginia
B. Sloothaak, R.M. Town, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Department of Biology; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)
Surface waters are continuously facing a variety of anthropogenic stresses, including pollution, habitat degradation, and loss of connectivity. In such complex and dynamic environments it is challenging to unambiguously establish the effects of trace metal contamination on the resident organisms. The European Water Framework Directive (WFD) obliges member states to set specific water quality
guidelines for surface waters, in order to reach a good ecological water quality status for all water bodies. Nevertheless, many rivers and streams are still experiencing trace metal concentrations that exceed the current Environmental Quality Standards (EQS). In combination with other stressors, this situation may lead to an unfavorable shift in the composition of the ecological community due to a variety of direct and indirect effects. The range of concomitant contributing processes is variable, but a prominent or limiting factor in many ways in which aquatic environment and community will respond to the presence of a stressor(s). To gain insights into the contributing factors, we are investigating eleven sites for which apparently contradictory effects are observed. That is, based on monitoring data (www.vmm.be/geoview) gathered by the Flanders Environment Agency (VMM), the sites that have an exceedance of the EQS, yet a good ecological quality is observed, we explored for contributing factors in a bottom-up approach. The main goal of the present study is to better understand the effects of waterborne heavy metals and their mixtures on a freshwater fish. Common carp were exposed to sub-lethal concentrations of Cu and Zn and different combinations thereof for a period of one week at a temperature of 20°C. Our aim is to assess the effect of sub-lethal concentrations of Cu and Zn on fish survival rate, determine the bioaccumulation of heavy metal in the gills and assess changes in gene expression of cell lineages related to ionoregulation, oxidative stress and defence mechanisms. Preliminary results indicate that metal accumulation induced expression of metal binding and stress proteins, and metal specific compensatory effects were seen in genes related to ionoregulation and oxidative stress. Further analysis will determine whether antagonistic, additive or synergistic effects occurred.

**TH269 Effects of heavy metal mixtures on bioaccumulation and defence mechanisms in common carp, Cyprinus carpio**
G. Casardeo, University of Antwerp / Biology; G. De Broeck, University of Antwerp / Biology SPHERE; B. de Feyter, University of Antwerp / Department of Biology (SPHERE Research Group)

The aquatic environment is continuously under threat because it is the final receptor and sink of waste streams. This environment receives a huge number of different compounds including heavy metals that can harm the health of aquatic organisms. The main goal of the present study is to better understand the effects of waterborne heavy metals and their mixtures on a freshwater fish. Common carp were exposed to sub-lethal concentrations of Cu and Zn and different combinations thereof for a period of one week at a temperature of 20°C. Our aim is to assess the effect of sub-lethal concentrations of Cu and Zn on fish survival rate, determine the bioaccumulation of heavy metal in the gills and assess changes in gene expression of cell lineages related to ionoregulation, oxidative stress and defence mechanisms. Preliminary results indicate that metal accumulation induced expression of metal binding and stress proteins, and metal specific compensatory effects were seen in genes related to ionoregulation and oxidative stress. Further analysis will determine whether antagonistic, additive or synergistic effects occurred.

**TH270 Silver nanoparticles exposure inhibits glycans synthesis and induces cytotoxicity in human cell line**
K. Shimizu, Toyo University; M. Horie, Advanced Industrial Science and Technology; S. Kashiwada, Toyo University / Graduate School of Life Sciences

Silver nanoparticles (SNPs) are used in industrial products worldwide. Hence, there are various concerns about silver nanoparticle pollution risk. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycans are one of the toxic targets of silver nanocolloids (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNP would disrupt glycans function. Beyond medaka research as a vertebrate model in Environmental Safety Assessment (ERa) is a tiered process, where lower tiers (steps) are designed to identify and exclude uncritical scenarios so that only potentially critical scenarios need more detailed evaluations. Therefore a guiding principle in the regulatory process is that in a first tier some over-conservative assumptions can be made, if they allow to correctly identify scenarios of low risk. If formulation studies are available, the measured toxicity of the mixture (and exposure to it) should be used in ERA. When
a calculation of cumulative risk is needed based on active substance endpoints, risk indicators that have already been calculated for single substance ERA such as toxicity exposure ratios or risk quotients should be used to describe the cumulative risk. In a first simple step different endpoints, species and PECs in time and space can be mixed, to show that a given scenario is of low concern. After that first step, a mixture toxicity assessment would describe the cumulative risk more precisely at a given time and place for a defined species and the same endpoint.

TH274 Sublethal toxicity of pesticide mixtures on early life stages of non-target aquatic organisms
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Pesticides are widely used throughout the world in many agricultural and domestic activities. By their presence in the environment, they can have an impact on non-target organisms. Moreover, due to the persistence of some products and the formation of active metabolites, more or less complex mixtures of pesticides can be found in the environment. Thus, the aim of this study was to evaluate the effects of one herbicide (S-metolachlor and his two metabolites) and an insecticide (imidaclopride) on the embryo-larval development of two non-target aquatic organisms. These pesticides are the most abundant representatives of their groups in the environment. The results showed that SES did not have an impact on the concentration in this Bay (1 µg/L for herbicides and 0.2 µg/L for insecticide and 2-3 higher concentrations) and their sub-lethal effects on the oyster (C. gigas), which is widely present in the Bay due to oyster farms and the zebrafish (D. rerio), chosen as a prototypical (eco)toxicology model organism. Firstly, the embryos were exposed to the separate substances, then the mixtures for 5 days (zebrafish) or 2 days (oyster). The malformations, the locomotion activity and target gene expression levels were assessed to understand the mechanisms of possible sublethal toxicity of the selected pesticides. According to our results, no malformations and no effect on locomotion activity for the tested concentrations were observed for zebrafish. On the contrary, the effects on locomotion activity of the oyster larvae is already induced at low concentrations of the selected pesticides. The first results of the gene expression show an overexpression of some of the selected genes of zebrafish (12S, TR-beta – known to be related to the thyroid disruption) caused by one of the metabolite metabolites. In conclusion, an indication of a novel mode of action of the chronic pesticide toxicity has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.

TH275 Including multistress in risk assessment of pesticides. Current state of knowledge, based on a literature review and evaluation of tank mixture applications in a spraying schedule for strawberries.
P. Moatti, University of Copenhagen / Department of Plant and Environmental Sciences; M. Álvarez Caero, H. Antezana Fernández, Universidad Mayor de San Simon / Facultad de Ciencias y Tecnología; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences
This study presents a new expression show an overexpression of some of the selected genes of zebrafish (12S, TR-beta – known to be related to the thyroid disruption) caused by one of the metabolite metabolites. In conclusion, an indication of a novel mode of action of the chronic pesticide toxicity has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.

TH276 MODELLING ACUTE AND CHRONIC RISKS OF PESTICIDES RESIDUES IN SOUR CHERRIES
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To destroy or prevent insects, rodents, and weeds that might harm agricultural crops, and to control and mitigate plant diseases, farmers started to use pesticides, which are highly toxic chemicals or mixtures. Due to their persistence in the environment and ability to bioaccumulate in living organisms, pesticides generate environmental and human health impacts and risks, which are in a complex relationship. The present study proposes a model, including strategies to regulate and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMo model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practices (GAP), in order to control the pests ensuring the safety of the plants subjected to the experiments. We followed variation of environmental conditions: temperature, humidity, rainfall patterns and pesticide dissipation in time considering each treatment. The results of pesticides concentration at harvest allowed us to model the pesticides risks to human health. Based on our assessment, it appears that acute and chronic risks of pesticides residues in sour cherries are low. Sour cherries dietary intake of pesticides residues poses an acute risk for children lower than 64.6% and lower than 22.5% for adults. The highest chronic risk level reached 2.4% for adults and 9.5% for children. Our study suggests that the risk assessment estimates are strongly influenced by age and dietary preferences.

TH277 Environmental and Human Cumulative Risk Assessment of Pesticides Using Local Monitoring Data: A Case Study from the Pucara River Basin, Bolivia
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In Bolivia, pesticides are one of the main contributors to the contamination of their imports and farmers ignore the toxicity of these compounds. Thus, cases of pesticide intoxication and pollution of natural ecosystems are common. In this study, we performed a cumulative risk assessment of measured concentrations of atrazine, 5 organochlorines and 5 organophosphates (many of them banned) in water and sediment samples from the Pucara river basin. Samples were obtained from 11 sampling points in the river basin. Pesticides from water samples were extracted by liquid-liquid extraction and from sediment samples by Soxhlet extraction. They were then quantified by gas chromatography. The toxicity data of each pesticide were obtained from online databases. Combining the exposure and toxicity data, the environmental risk (sum of toxic units (SU)) was calculated for four target organisms (D. magna, fish and C. riparius, and HI for chronic exposure reached values of 4.70 and 1.57 for children and adults, respectively. The results suggest that pesticide pollution likely impeded the stream system biota in multiple points, while water was not acceptable for a human daily intake in two sampling points, especially for children. The detected pesticides that caused most harm were heptachlor (banned) and dimethoate (approved). Based on these results, risk management strategies should be highly prioritized in order to reduce the risk posed to the ecosystem and the human health in the studied area. However, further studies should analyse the pesticide levels in other times of the year to see if the current results are representative. It is also necessary to analyse a higher number of pesticides which include an even representation of herbicides, fungicides and insecticides, to be sure that risk is not underestimated.

TH278 Developing a strategy to improve the environmental risk assessment of pesticides: to test multi-component substances: a new HESI Emerging Issues Committee
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An international workshop was held in 2016 to address challenges in assessing ecological risk of complex mixtures of substances derived from pesticides (banned) and dimethoate (approved). Based on these results, risk management strategies should be highly prioritized in order to reduce the risk posed to the ecosystem and the human health in the studied area. However, further studies should analyse the pesticide levels in other times of the year to see if the current results are representative. It is also necessary to analyse a higher number of pesticides which include an even representation of herbicides, fungicides and insecticides, to be sure that risk is not underestimated.
environmental risk assessment. Bridging from the workshop discussions and conclusions, a new HESI Emerging Issues Committee was formed in late 2017, with the overall mission to develop a tiered approach to UVCB and MCS ecological risk assessment. Initial objectives of this committee are to identify and develop models and methods, develop best practices and guidance, and engage with multi-stakeholder collaborative research projects. This presentation will highlight the initial goals and strategy of this multi-stakeholder, collaborative group.

TH279 Environmental Risk Assessment of Technical Mixtures under REACH E. Hassold, W. Galert, German Environment Agency - UBA / IV 2.3 Chemicals; W. Dres, Federal Environment Agency (UBA) / Chemicals Adaptation of all types of substances regulated under REACH end up in mixtures. During their processing and downstream-use substances are blended together in formulations, are reformulated for different uses and end up in a variety of products. REACH addresses the safe use of single substances in technical mixtures, but not explicitly the risks arising from joint effects and exposures of the components. In contrast to other substance-oriented regulations, not the authorities, but the registrants and down-stream users have to assess and guarantee the safe use of the registered substances, formulations and products. Recently, some attempts have been made by industry organizations with the concept of LCID/SUMI to improve the assessment and communication of safe use conditions for technical mixtures. However, essential improvements are needed. The development of sound prioritization criteria is essential for a mixture assessment. But a sole consideration of the chemicals in a mixture is not sufficient. When classifying a mixture as such, it only applies for a minority of substances and further hazardous substances may be missed. All substances with ecotoxicity data need to be considered together with information on uses and exposure. The methods for an assessment of mixtures including component-based approaches, whole mixture testing, identification of main drivers and tiered assessment strategies are in general available. These need to be transparently addressed, so that further calculations by other down-stream user are possible. The quality and availability of hazard and exposure data is central and data (eventually considering an anonymization of CBI) needs to be communicated between registrants and down-stream user in the supply-chain to reach the respective “mixture evaluator”, i.e. the formulator. Communication formats (e.g. extended SDs + SUMI) as well as central data bases seem promising and need to be built up. Indeed, detailed guidance and assistance is needed for formulators of mixtures to enable the assessment of a safe use of mixtures. An implementation in guidance documents needs to involve all stakeholders (authorities, industry, academia) and approaches should be followed and evaluated with respect to their feasibility and a sound risk assessment in case studies.

TH280 Natural complex mixtures: Ecotoxic behaviour, what we know and what is next? R. SAMSERA, CETHRA SAS; N. DELPIT, Laboratoires des Pyrénées et des Landes; P. Bichere, KREATiS; J. Rivera, A. Barret, C. durou, CETHRA SAS; P.C. Thibault, CETHRA SAS / Ecoregions and Ecosystems are not analizable, as they only apply for a minority of substances and further hazardous substances may be missed. All substances with ecotoxicity data need to be considered together with information on uses and exposure. The methods for an assessment of mixtures including component-based approaches, whole mixture testing, identification of main drivers and tiered assessment strategies are in general available. These need to be transparently addressed, so that further calculations by other downstream user are possible. The quality and availability of hazard and exposure data is central and data (eventually considering an anonymization of CBI) needs to be communicated between registrants and downstream user in the supply-chain to reach the respective “mixture evaluator”, i.e. the formulator. Communication formats (e.g. extended SDs + SUMI) as well as central data bases seem promising and need to be built up. Indeed, detailed guidance and assistance is needed for formulators of mixtures to enable the assessment of a safe use of mixtures. An implementation in guidance documents needs to involve all stakeholders (authorities, industry, academia) and approaches should be followed and evaluated with respect to their feasibility and a sound risk assessment in case studies. With June 2018 coming, the registration steps of chemicals under REACH review program come to an end but with much more to follow. But now it is time to consider the overall tasks we performed to meet that 2018 deadline. All the different classes of organic substance under REACH were considered during the Phase-in period: monocatagonics, multiconstituents, & UVCBs. Amongst these substance types were several famous test cases presented at REACH testing especially in ecotoxicology and environment. One of the most challenging groups was fragrances. In fragrance chemicals can fall under multiple categories: natural, synthetic, mononconstituent, multiconstituent or considered as UVCBs. One group of fragrances that fell under the title of multiconstituent/UVCB were known to be particularly difficult to assess: Essential oils (EO). EO are complex mixtures, with differing but often low solubility, high volatility and are known to contain some toxic constituents such as terpenes. We met some even more complex substances in this family: gums, resins and concretes, sub-categories of essential oils. They were as complex as EO but their composition was mostly unknown and their physical state leads to further difficulties for ecotoxicity testing: they were (mostly) solidifying, extremely viscous resins, with a frozen honey-like texture. We tested hypotheses and performed ecotoxicology and e-fate studies on all the different classes of these substances (gums, resins, concretes and everythine in between) to optimize our testing strategies for such compounds: we will necessary avoidance of some using strategies of several approaches. We wish to present our hypothesis and overall conclusions on the probable next steps for these complex substances.

TH281 Testing chemical mixtures: how to determine the effects concentration(s)? G. Deviller, DERAC / TERA PRAPS HSE When the properties of a mixture cannot be estimated from the related properties of its components then testing on the mixture is required under most chemical regulations. However, the available standard methodologies to assess the environmental fate and toxicity have been developed for single substances and are often not directly applicable to mixtures. The first issue is related to the identification of the relevant constituents to monitor during the tests (e.g. composition main constituents, bioavailable fraction...) which may differ according to the substance regulatory frame(s). Second, the development of a specific and quantitative analytical method for each relevant constituent could be technically challenging because (1) all analytical standard substances might not be available since some constituents of the mixture are produced by reaction and (2) the different chemical nature of the constituents may require different type of analytical techniques that might not be (all) available in the (same) GLP testing laboratory. Once the analyte and method have been selected the effects could arise during toxicity tests if one or more constituent's concentrations vary during the exposure time. Indeed, if the constituents are found to be all stable, then the effect concentrations (e.g. ECx or NOEC) can be based on the nominal concentration of the mixture. But, in case the constituents have different degradation patterns during the test then, how the recommendation for single substances to base the effects concentrations on the measured concentration should be applied for these mixtures? This presentation is intending to discuss these issues and to bring some elements of response based on case studies.

TH282 Deriving USEtox human non-cancer toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, M. Fuart-Gatnik, M. Pavan, S-IN Soluzioni Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit The Product and Organism Environmenal Footprint (PEF/OEF) methods form a core part of the European Commission (EC) Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). Based on these methods, the potential impact on humans and ecosystems of chemicals emitted during the life cycle of a product is assessed via the USEtox model. To this aim, USEtox makes the models and datasets available for a chemical. Focusing on human health (HH), the EC Joint Research Centre has recently obtained from the European Chemicals Agency (ECHA) genotoxicity and repeated dose toxicity (RDT) data (41’381 test results, as of March 2017) generated under the REACH Regulation. Based on these data, data-selection criteria were defined to automatically derive non-cancer HH toxicity effect factors (using R-studio) for thousands of chemicals in USEtox. Genotoxicity data were not retained in the assessment, being associated with qualitative outcomes, and rules for cancer HH effect factors were not derived, since the USEtox ED50, and cancer-TDS50 endpoints are not commonly provided under REACH. According to the USEtox methodology, specific fields of the REACH data, included in the RDT endpoint study records (ESRs) via the oral and inhalation route, were used to define selection criteria for non-cancer HH effects, in particular: reliability, adequacy, type of information, test guideline, GLP, species, duration of exposure, route of administration, effect level qualifier, effect level, unit, effect level based on, basis for effect levels. A tiered approach for selecting good quality data was also proposed, based on four quality levels, where studies of the highest quality (key studies, Klimisch 1/2) were included in the first two levels. The challenges that we faced included the way of data reporting and detailing in ESRs, especially for some critical fields, e.g. endpoint, unit, test duration, of exposure, thus leading to the use of other general rules for computing reasons, or other fields in their substitution. Nonetheless, the final effect value per chemical (e.g. NOAEL), automatically derived from REACH data based on the developed criteria, coincided with the critical endpoint value chosen in the ESR in the majority of cases. Based on this work, RDT REACH data for thousands of chemicals can automatically be selected and used for their life cycle assessment in USEtox.

TH283 Deriving USEtox aquatic freshwater toxicity Effect factors from OpenFoodTox database using R-Studio program E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, S-IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSA / Scientific Committee and Emerging Risks Unit Department of Risk assessment; J. Richardson, EFSA / AMU; D. Versteeg, EcoStewardship LLC Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF) form a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). There are currently 25 PEF and 2 OEF pilot testing Product Category Rules (PCR) that will involve the potential input data for a chemical. A mixture is assessed via the USEtox multimedia fate model [3]. This model requires ecotoxicity data to freshwater aquatic life. For PEF/LO, those data are required for thousands of chemicals using the most up-to-date information [4,5]. The EFSA OpenFoodTox database was used to extract the information required to calculate effect factor for Plant Protection Products. EFSA has populated a chemical hazards database to hold summary hazard data from EFSA’s chemical risk assessments in food and feed (Barbaro et al. 2015; Dorne et al. 2017). The data are freely accessible via the EFSA website OpenFoodTox but also accessible via downloadable Excel files. From the OpenFoodTox database, 2695 ecotoxicological observations were
available for about 451 chemicals. After selecting the appropriate data, species geometric means have been calculated for each taxonomic groups. The following final calculation have been performed for thousands of chemicals: - Acute and Chronic species geometric means with standard deviation and number of individual test available per species - Arithmetic average of all the log of the species geometric mean with standard deviation and count of species as well as count of SSD group for each chemical and Chronic species geometric means with standard deviation. Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TH284
Bioassays for assessing effects of overall mixture from food contact materials K. Flesch, Foundation; J. Muncke, Food Packaging Forum Foundation / General Management
Food contact articles (FCAs) are made from highly diverse materials, and they are chemically complex. FCAs can transfer their chemical constituents, the so-called food contact chemicals (FCCs), into foods. Exposure to FCCs is assumed to be highly relevant in the context of human exposure to (synthetic) chemicals. To assess the risk to human health from chronic ingestion of FCCs, basic information on migrating chemicals must be available, such as their chemical identity. However, this is often not the case for all migrating FCCs, especially the non-intentionally added substances (NIAS), as some or most NIAS typically remain unknown, depending on the type of FCA. Furthermore, the current approach to chemical risk assessment is focused on single substances, while it is known that many FCCs migrate simultaneously, forming the ‘overall migrant’ and resulting in typical and predictable mixture exposure scenarios. One alternative approach to estimating chemical hazards of FCAs is to assess biological effects of the overall migrate. In addition to assessing mixture toxicity this approach also includes effect-assessment for unknown NIAS which otherwise remain unassessed. We review this approach, discuss benefits and disadvantages, and highlight future research needs.

TH285
Inspired by methods and tools developed in the field of life cycle analysis (LCA), we propose a tool to create a single index to appreciate the harm done due to the presence of radioactive materials and wastes for human and environmental health. Six impact categories were considered: human cancer and non-cancer effects on one hand, and ecotoxicity on the other hand, both considering chemotoxicity and/or radioxicity. For ecosystems, a comparative toxic unit has already been defined from which we derived our noxiousness index. It is based on the concept of Potentially Affected Fraction (PAF), used here as a damage indicator at the ecosystem level. This concept expressed initially the toxic pressure on the environment due to one chemical. It has been enriched to mixtures of substances as multi-substances PAF (ms-PAF), and yet applied to a mix of stable and radioactive substances. Combining ecotoxicity data and a simplified model of exposure of fauna and flora, we proposed a chemotoxicity index and a radioxicity index, which definitions ultimately allow the calculation of a single index. According to acknowledged practices in LCA and corresponding available data, we suggested declining this approach to human health, taking into account exposures resulting from both ingestion and inhalation pathways. This led to eight basic indices, which may be aggregated on substances, effects categories or exposure pathways to produce intermediate indexes. The principle of additivity that underlies the whole proposed approach may authorize their complete aggregation in order to produce a unique index also for human health. Different source terms may be then easily directly compared in terms of human and ecological noxiousness.

TH286
Solution-focused application of mixture modelling and chemical footprints M.C. Zigg, RIVM / Centre for Sustainability Environment and Health; J. van Gils, DELTAres; A. van Weelz, KWR Watercyle Research Institute / Chemical Water Quality and Health; D. De Zwart, DdZ Ecotex / Centre for Sustainability Environment and Health; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Science; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health
Status reports of the Water Framework Directive suggest many cases of non-compliance according to formal criteria for Good Ecological and Good Chemical Status as well as for River-Basin Specific Pollutants. This signals problems for both the assemblages of species and the functions we try to protect. Multiple stressors, including 100k chemicals and their mixtures, are the causal agents. In the FP7 project Solutions, a modelling train is developed with the purpose to support derivation of water quality management plans that provide best value for money regarding chemicals and their mixtures, i.e., help to identify the largest potential risk reduction per euro spent. Thereby, the challenge is to focus on those chemicals that matter most, which can result in prioritization to sites (where are largest impacts to be expected), to times (when are largest impacts to be expected, e.g., crop-growing season & pesticides), to affected species groups (which species (groups) are most sensitive to the present impact) and to compound (which chemical (groups) contribute most to local impacts). Collaboration with the FP7-project MARS (on multiple-stress effects on ecological status) forms a multi-stress, multi-chemical in-depth model. In SOLUTIONS, the modeling train will result in complex chemical footprints (ChF). ChFs were developed to summarize and communicate predicted mixture risks in simple units. In the current presentation, ChFs are evaluated in terms of the net contributions to predicted mixture impact of emissions in one region, e.g., a sub-catchment, on the mixture toxic pressure in the total river downstream, including the estuary. Hence, it extends the potential transformation from one source to one receptor, including the information that can be obtained by single-chemical risks, chemical footprints indicate which combination of chemicals and locations require priority for abatement. We present ChF-analysis results for the river Rhine. The river basin was divided in more than 800 sub-basins and chemical footprint information resulting from the emissions of a large amount of chemicals are derived from hydrology driven spatially and temporally explicit modelling for the whole catchment. Subsequently, abatement priorities are proposed, based on the ChF results, that act on the most severe combinations of chemical and region of emissions. The effects of local risk management are expressed in reduced toxic pressure in all downstream sections of the river.

TH287
One-week observation of phthalate metabolites in urine from 12 Korean adults: Exposure levels, profiles, and source identification J. Lim, Hanyang University; S. Kim, Seoul National University Graduate School of Public Health; I. Lee, Seoul National University / Department of Environmental Health Sciences; A. Lee, Soonchunhyang University; S. Kim, Y. Kho, Eulji University; J. Park, SOON CHUN HYANG UNIVERSITY / College of Natural Sciences; K. Choi, Seoul National University / Environmental Health Sciences; H. Moon, Hanyang University / Marine Sciences and Convergent Technology
The esters of phthalic acid (phthalates) are representative endocrine disrupting chemicals (EDCs) to cause a variety of adverse health effects to humans. Phthalates have been primarily used as additives of the plastic products, cosmetics and personal care products (e.g., DEP). Phthalates are metabolized and eliminated in urine within few hours after human exposure. Due to a short half-life of phthalates, the urinary phthalate metabolites are utilized as an indicative for integrative exposure to phthalates from multiple sources and pathways. In this study, all of the urine samples for 7 days (n=401) were collected from 12 adults to identify the exposure level, profiles, and source identification of phthalates for different population groups. Eighteen phthalate metabolites include mono-ethyl phthalate(MEP), mono-ethyl phthalate (MEP), mono-2-ethyl-hexyl phthalate (MEHP), mono(2-ethyl-5-oxohexyl) phthalate (MEHP), mono-2-ethyl-5-hydroxyhexyl) phthalate (MEHP), mono(2-carboxyethylhexyl) phthalate (MCMEH), and mono(2-ethyl-5-carboxypentyl) phthalate (MECPP) were analyzed. Among 18 phthalate metabolites, MEHP, MEOPH, MEPHP, PCMHP, MCPP, MBzP, MEP, and MBzP were detected in almost all of the urine samples (detection rate >97%). However, MCHP, MzEP, MzNP, MOP, and MEP were rarely detected in all of the urine samples (< 10%). Total concentrations of phthalate metabolites ranged from 3.12 to 6300 ng/mL with a median concentration of 104 ng/mL. Five DEHP metabolites were detected in almost all of the urine samples (detection rate >97%). Exposure levels, profiles, and source identification of DEHP from multiple sources. In the present study, we defined the peak exposure level, profiles, and source identification of DEHP from multiple sources.

TH288
Integrating chemical monitoring data with high-content effects data to prioritize contaminant and hazards in chemical mixtures D. Martinez-Weigl, University of St. Thomas / Biology; A.C. Mehnito, Southern California Coastal Water Research Project / Toxicology; N. Vinas, US Army Engineer Research and Development Center; A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; E.M. Curran, University of St. Thomas; C. Lai, University of St. Thomas / School of Engineering; Y. He, University of St. Thomas / School of Engineering; M.L. Ferrey, Minnesota Pollution Control Agency / Environmental Outcomes
Determining ecological risks associated with exposures to complex chemical mixtures in the environment is challenging. Bioeffect-based monitoring tools that can measure integrated biological activity of mixtures have been proposed as one of
the solutions. A limitation of these is that they typically do not provide insight into which chemicals are causing the observed biological responses. Utility of methodologies that integrate chemical monitoring with bio-effects data to prioritize chemicals and hazards in complex mixtures will be discussed. More specifically, outcomes of a Minnesota streams case study are used to critically evaluate approaches where: 1) prior knowledge regarding toxicity of detected chemicals is combined with empirical, in situ bio-effects assessments; and 2) where in situ chemical and occurrence data in situ bio-effects data are integrated directly (without the prior knowledge of toxicity of individual chemicals). Samples from 50 randomly selected locations in Minnesota were analyzed for 146 chemicals of emerging concern. Concurrently, at 10 sites, exposures of fathead minnows to stream water were conducted (48h, custom 60K feature microarray platform, liver, NOx, lipid profile, and lactate concentration). These chemicals and public bio-effects data for individual chemicals were integrated to prioritize chemicals and predict biological targets of detected chemicals for each site. Partial least-squares (PLS) regression and association rule learning (AR) were used to identify associations between in situ chemistry and in situ transcriptomic effects. At most sites, both prior knowledge-based predictions and fish transcriptomics, indicated activation of estrogen receptor alpha and peroxisome proliferator-activated receptors; their predicted chemical initiators were bisphenol A, caffeine, carbamazepine, and triclosan. Some chemicals (triclosan) were indicated by both knowledge-supervised and direct data integration approaches, but iodamidol (detected at 78% of MN sites) and metformin were only indicated by PLS and AR. Estrogenic effects remain of special concern as all methodologies indicated disruption or estrogen receptor signalling. Collectively, and adding to toxic stressors, these chemicals occur not only in sewage and rainwater but are also used in many industries.

TH289 CENTRAL ASIA POLLUTION: OBSCURE TAILINGS, OBSCURE PESTICIDES, OBSCURE GASOLINE AND HUMAN HEALTH DISORDER

I. Hadjambelev, Toxic Action Network Central Asia; Chief Scientific Officer; A. Rospokova, Asian Medical Institute named Tentishiev; V. Didenko, Asian Medical University named Tentishiev; I. Kniazev, Asian Medical Institute named Tentishiev; B. Hadjambelev, Toxic Action Network Central Asia

We study the radioactive and toxic wasteage health impact: in areas of tailings and obsolete pesticides, and severe air-environment pollution by obsolete gasoline. They all have the same targets - immunity, genetic, endocrine system. The old uranium mine tailings of former USSR military industry in Central Asia, especially in North Tajikistan (tremendous Degmay); in Kyrgyzstan – 29 tailings (high concentration in MailuuSuu river cost), in Uzbekistan 11 tailings and mines. Total radioactive wastages volume of three CA countries – 700 mln ton. There are 268 warehouses of obsolete pesticides and abandoned airfield used for agro-pulverization. These warehouses and tailings could pollute distant areas of CA by infiltration by rivers. Additionally toxic stressors are gasoline, municipal waste incinerated cars. These three health hazard datasets, and relatively small sample sizes pose challenges for utility of PLS and AR, whereas poorly populated knowledge bases, lack of fish-specific data and poorly characterized in vitro models are problematic for knowledge-based predictions.

TH290 Evaluating HPC ingredients in WWTPs & surface water of the Songhua Catchment using monitoring & high tier modelling tools

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Introduction: Ingredients commonly used in home and personal care (HPC) products can enter the aquatic environment after use if they are not completely removed during wastewater treatment. We investigated the occurrence and fate of a range of widespread used ingredients in HPC products in wastewater treatment plants (WWTPs) and surface waters of the Songhua River catchment (China) using a high tier modelling framework and monitoring. The aim of our study was to advance understanding in the occurrence and fate of ingredients found in HPC products in the Songhua catchment, in particular 1) to assess spatial trends in the catchment, and 2) to evaluate and improve modelling predictions. Methods: A monitoring campaign was carried out by I/RUC-PTS, in the Songhua catchment (China) undertaken from June-July 2017, sampling WWTPs and watersheds. WWTPs and surface waters were monitored to represent data based on product sales data for China and were input into the modelling framework. The hydrobiosinological dataset has been integrated within the Pungea multiscale multimedia modelling framework, using the hydrological flow between each basin and its downstream basin to parameterize the transfer rates from the corresponding water compartments. Results: In situ measurement results for the Songhua catchment indicate the concentration of HPCs are dominated by LAS in WWTPs and rivers. Modelled influent concentrations show good agreement with measured concentrations for most ingredients, demonstrating emission estimates are reasonable. WWTP median measured removal rates range from 90.6% for TCS up to 99.8% for LAS. In the freshwater compartment there is good agreement, with the model overpredicting concentrations for most ingredients. Conclusion: Our combined modelling and monitoring approach is advantageous for assessing exposure, as monitoring data can be used to evaluate model predictions and refine parametrization while modelling provides feedback to improve the representativeness of sampling. This method enables a more detailed analysis of the key sources of uncertainty and variability at each step of the modelling framework (i.e. emission, effluent and river concentrations). Further work to understand the uncertainties in both monitoring and modelling will be carried out in a monitoring campaign in November 2017.

TH291Microcosm experiment evidences complex responses of biofilms communities along a gradient of chemical pollution

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Freshwater ecosystems are receivers of chemical pollution, which has been recognized as one of the main causes of river impairment. Wastewater treatment plants (WWTP) are point sources of contaminants in natural receiving waters but information about their effects in the ecosystems is still scarce. Ecosystems are known to react to any environmental change by initiating a series of ecological and chemical processes that are difficult to subsume in an exhaustive description. The objective of this study is thus to verify how robust and resilient is an ecosystem to WWTP effluents using a microcosm experiment which have been revealed as particularly convenient tool to study biological communities’ responses. We exposed twenty-four artificial streams to a range of WWTP effluent concentrations, from no effluent to pure effluent and under controlled conditions of light and water flow during 24 days, followed by 22 days of recovery. We analysed river biofilm inhabiting in sediments and cobbles surface because of its major role in ecosystem functioning. To assess impact and recovery we measured Chlorophyll-a content, Chlorophyll-a fluorescence measurements, extracellular enzyme activities (APA and LAP), algal community and metabolism at weekly scale. Pollution load associated to the WWTP effluent was characterized analyzing physical-chemical parameters (pH, dissolved oxygen, conductivity and temperature), nutrients, organic matter, heavy metals and microcontaminants in the water phase. Our preliminary results indicate a complex response of stream ecosystem functioning in front of the WWTP effluent. We notice changes on the system balance and the final return to equilibrium. Acknowledgements - The research leading to these results has received funding from the European Communities 7th Framework Program under Grant Agreement No. 603629-ENV-2013-6-2.1-Globaqua

TH292 Risk assessment of chemical mixtures in the Erft river basin


Mixture toxicity was assessed using extensive chemical monitoring data from the river Erft, its tributaries, and ten municipal waste water treatment plants (WWTPs) draining into the Erft catchment. Toxic Unit analysis and assuming concentration addition and using acute toxicity endpoints for algae, macrophyts, daphnia and fish. Substances with high TU as well as the taxonomic groups displaying highest added up TU response (SUM TU) were determined. The chemical inventories of WWTP effluents were analysed to gather information on non-detects i.e. potentially ecotoxicologically relevant substances which are present in surface waters in concentrations below the analytical limit of detection (LOD). Additionally, single substance risk assessment was performed by determining risk quotients (environmental concentration/PNEC). Risk quotients larger than one indicate a possible risk for aquatic organisms. SUM TU were mainly 483 SETAC Europe 28th Annual Meeting Abstract Book
explained by few compounds which varied between sampling sites and dates (e.g. seasonal use of pesticides). Overall, WWTPs increased mixture toxicity in the receiving surface waters. For most samples highest SUM TU could be calculated for macrophytes and algae. As a substance highly toxic for algae Triclosan generated high TU. It was detected in nearly all WWTP effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered to be a potential risk for the aquatic organisms. In waterbodies strongly influenced by WWTP discharges Diclofenac and Ibuprofen were nearly ubiquitous and caused high chronic toxic stress to fish. It was concluded that a combination of single substance risk assessment and mixture toxicity assessment is a suitable tool to evaluate complex monitoring data. Monitoring of substances with high TU (contributing mainly to mixture toxicity) could help to identify surface water for a more extensive monitoring and support specific management planning.

TH293 Assessing groundwater toxicity of emerging contaminant mixtures
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Groundwater is one of the most important natural resources, as globally it comprises the primary available source of freshwater. Groundwater aquifers consist in an important drinking source in many parts of the world and a point of supply for irrigation in agriculture, among others. Additionally, groundwater aquifers are considered valuable in sustaining ecosystems’ health and functioning. The Groundwater Directive (2006/118/EC) was created to protect groundwater bodies from contamination but to date it does not consider a diverse array of emerging contaminants in large quantities by society. These emerging contaminants can often occur in mixtures rather than alone, therefore understanding and predicting the toxicity of such complex mixtures, will eventually lead the way to developing new strategies for setting adaptations in regulations. Additionally, adapting surface water protocols to groundwater contamination scenarios might lead to erroneous results due to water different composition. The present work was performed in the context of the European Research Project WE-NEED (Water JPI- WATERWORKS2014 ERA-NET) focused on developing new management strategies to sustainably exploit groundwater resources. A thorough identification of emerging contaminants took place in two well-characterized case-studies, the Bologna and Cremona aquifers. For that, four priority contaminants identified in the two aquifers were chosen as model chemicals and synthetic water was built to mimic surface water from the Bologna and Cremona aquifers. The acute toxicity of complex mixtures in these synthetic groundwater was tested in Daphnia magna and deviations from the Concentration Addition reference model were assessed. Based on this step, the toxicity of three emerging compounds and their mixtures (binary and ternary) were assessed in the two synthetic groundwaters using adapted standardized protocols for Daphnia magna (OECD 202) and Danio rerio (OECD 238). The use of these models and synthetic groundwater allowed the evaluation of the mixture toxicity of binary mixtures used to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicated interaction between the contaminants in D. magna and D. rerio.

TH294 Mixture effects of Dibutyl phthalate and Sodium dodecyl sulphate on a mesozooplankton community from the Swedish west coast
C. Jonander, University of Gothenburg; I. Dahlöf, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Dept of Biological and Environmental Sciences
Mesozooplankton communities generally possess a large resilience to chemical exposure. Potentially, structural changes on this level could indirectly affect even higher levels of biological complexity. We used copepod egg production, hatching success and feeding rate as our primary ecotoxicity parameters, complemented with dead/alive staining of zooplankton with neutral red after the exposure. Additionally, we analysed the community structure before and after chemical exposure by image analysis, comparing images of the exposed samples and untreated controls to a manually classified reference library of mesozooplankton taxa. Single substance experiments show toxic effects on the zooplankton communities by decreasing copepod egg production and hatching success in a concentration-dependent manner, with first effects becoming visible at concentrations of 0.20 μmol/L (DBP) and 0.32 μmol/L (DBS), respectively. The position of structural endpoints as well as the mixture experiments are currently (Nov. 2017) ongoing and will be presented on the poster.

TH295 Analysis of the Mixture toxicity burden in 17 Rivers in North Eastern Australia - Implications for the Great Barrier Reef
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The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. It runs for approximately 3000 km along the coastline in north-eastern Australia. A total of thirty-five major river basins discharge to the GBR and many transport large loads of pesticides, suspended sediment, nutrients from agricultural land. Over the past 6 years an extensive program has been conducted by the Queensland Government to monitor concentrations of 51 pesticides and their breakdown products in 17 rivers that discharge to the GBR. To explore the potential impact of these pesticides on marine and coastal environments and to the GBR we analysed the risk posed by the individual pesticides and their mixtures. Australia currently does not have water quality guidelines for 17 of the 38 pesticides detected. For those, we calculated ecotoxicity thresholds using a simplified version of the Australian methodology for determining water quality guideline values, based on species-sensitivity distributions. In all rivers, multiple pesticides were routinely detected at concentrations significantly higher than their level of reporting. All rivers had at least one sample where the combined toxicity was greater than 1 toxic unit (TU), i.e. exposure situations where the total pesticide concentration exceeded acceptable levels. In a number of rivers more than 50% of samples had a combined toxicity greater than 1 TU. Average TU’s per river ranged from 13.47 to 0.10, with substantial fluctuations over the seasons but without clear trends between years. The patterns indicate that specific events such as severity of wet/dry seasons and cyclone events impact the combined toxicity found. We also found land use patterns affected the combined toxicity in the river ecosystems. In each of the rivers, 90% of the expected mixture toxicity was caused by only between 2 and 6 pesticides, although the individual pesticides that dominated the combined toxicity differed between rivers.

TH296 Physiological and transcriptomic responses in the tropical coral Stylophora pistillata to inorganic sunscreen exposure
A. Taghli, Heriot Watt University / Institute of Life and Earth Sciences; S.J. Hennige, The University of Edinburgh / School of Geosciences; T.F. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences
Between 16000 and 25000 tons of sunscreen are used annually in tropical countries with tourism linked to coral reef areas considered to be one of fastest growing tourism sector worldwide. Sunscreens are complex mixture of UV filters, emollients, and emulsifiers, and at least 25% of the cream is washed off from the skin during swimming and before. The lipids are the platform for the sunscreen and the resistance against degradation of these compounds, sunscreen products can reside in coastal waters and potentially biocumulate in aquatic animals. Therefore sunscreens may pose a major threat for marine organisms in the shallow water near tourist beaches. Organic UV-filters have been documented to cause bleaching both in adult and larval stages of corals but only few studies have addressed the impact of inorganic sunscreens. A common component of inorganic sunscreen are titanium dioxide nanoparticles (TiO$_2$) which are widely used as UV-filters in the cosmetic industry due to their transparency and broad spectrum protection along with absence of skin irritation. Results from previous experiments on corals’ symbiotic algae Symbiodinium indicate that sunscreen toxicity is likely driven by the oil content, and that the lipids are responsible for the toxicity of TiO$_2$ nanoparticles to the coral. We carried out experiments to test the effects of these sunscreen on corals, by studying coral photophysiology, coral respiration, symbiont density and chlorophyll content. The expression of genes involved in thermal stress (HSP70), carbon absorption (intra and extracellular carbonic anhydrase) and calcium and ATP exchange (CA-ATPase) were also analysed to characterize Stylophora pistillata transcriptomic response to sunscreen exposure. Results from this work will be presented and compared to other studies carried out with organic sunscreens. Results from the present studies are essential to understand how the exposure to inorganic sunscreens affects reef-building corals, and they will contribute to the development of effective conservation programs and support eco-tourism.
Economies.

TH297 Effect of antibiotic mixtures on the growth of Anabaena flos-aquae K. Budin, Environment Department, University of York / Environment; L. Carter, University of York / Environment Department; A. Agata, IBACON GmbH / Environmental Department; J. Wilkinson. The University of York / Natural and Built Environment K. Selby, Environment Department University of York; A. Boxall, University of York / Environment Department. Antibiotics can be released to the environment, following use in both human and veterinary medicine. As a wide range of antibiotics active ingredients are in use, the natural environment will be likely exposed to mixtures of these compounds. The environmental risks of these mixtures are however poorly understood. In this study, the toxicity of single and mixture of six major human antibiotics from different classes; amoxicillin (AMO), oxytetracycline (OXY), clarithromycin (CLA), meropenem (MER), ciprofloxacin (CPO), cephalaxin (CEP) to the blue green algae, Anabaena flos-aquae was assessed. All antibiotics showed high toxicity to the cyanobacteria with EC50 concentration ranging from 0.001 to 0.08 mg/L (CLA, 0.001 mg/L), (CPO, 0.003 mg/L); CIP, 0.008 mg/L; OXY, 0.006 mg/L; MER, 0.02 mg/L and AMO, 0.03 mg/L. Use of these toxicity data alongside predictions of surface water concentrations, using simple models, resulted in risk characterisation ratio values of 30.2, 2.5, 2.4, 1.9, 1.4 and 0.2 for AMO, OXY, CLA, MER, CIP and CEP respectively, suggesting that five of the six compounds may be adversely affecting the aquatic environment. The mixtures toxicity studies are ongoing but the available data shows; these will be used to evaluate the combination addition (CA) and independent action (IA) for estimating the mixture toxicity. The best performing model will then be used alongside exposure modelling approaches to explore the risks of mixture for different scenarios.

TH298 Exposure to mixtures of Persistent Organic Pollutants (POPs) can inhibit the transactivation activities of Aryl hydrocarbon Receptor (AhR) in vitro Q.T. Doan, Université de Liège (ULiege) / Département des Sciences des Denrées alimentaires; M. Muller, University of Liège / GIGA-R. Laboratory for Organogenesis and Regeneration; H. Bertens, NMBU-School of Veterinary Science / Department of Production Animal Clinical Sciences; K.Zimmer, NMBU-School of Veterinary Science / Department of Basic Sciences and Aquatic Medicine; S. Verhaegen, E. Ropstad, NMBU-School of Veterinary Science / Department of Production Animal Clinical Sciences; L. Connolly, Queens University of Belfast / Institute for Global Food Security, School of Biological Sciences; M. Scippo, University of Liège / Department of Food Science, FARAH. All living organisms are exposed to POPs as xenobiotics. In this study, three individuals compounds but as mixtures of chemicals. However, to assess the toxicity of POPs, scientific studies usually focus on the effect of one single compound at a time and do not address the cocktail effect of the mixtures, where different chemicals can act additively, antagonistically or synergistically to produce adverse effects. This study aims to determine, in vitro, the effect of a mixture of POPs at the level of the AhR transactivation function. AhR is a key receptor involved in an organism’s response to POPs as xenobiotics. In this study, three different luciferase reporter cell lines (rat hepatoma H4IE, human mammary gland carcinoma T47-D and human hepatoma Hep G2) were used to screen AhR transactivation activities (i.e. agonistic and antagonistic) of 29 compounds listed as POPs under the 2001 Stockholm Convention. Their mixture, prepared according to the environmental concentrations found in human blood, was also tested for the same activities. We show that these compounds have species- and tissue-specific effects and that the rat cells DR (Dioxin responsive)-H4IE are more sensitive than the two human cell lines (DR-T4-D and DR-HepG2). Only 6 out of them showed AhR agonistic activities. PBDE-153, PBDE-154, PCB-138, and PCB-118 were able to activate the AhR in DR-H4IE cells only, 1-2CH was active in DR-T4-D only, while PBDE-99 was found to be an AhR agonist in both cell lines. No agonistic effect was seen for DR-HepG2. In contrast, 19 out of the 29 compounds showed AhR antagonist activities in DR-H4IE, while 10 and 6 compounds displayed AhR antagonist activities in DR-T4-D and DR-M Hep G2 cells, respectively. Not surprisingly, the mixture of the 29 compounds also showed an AhR antagonist action on all cell lines. In DR-H4IE, AhR inhibition was observed with concentrations of the POP mixture corresponding to 75 times the blood level and above, which could be plausibly reached in humans after a food contamination incident. The IC50 for the POP mixture was 262.6 ± 104.6 times the background blood level, which corresponds to an interpolated antagonistic equivalent of 0.165 µM BDE-47, while only 0.0047 µM BDE-47 presents in the mixture at the IC50. In addition, the dose ratio coefficient of the mixture is 0.3 (< 1) according to additive mixture effect model. This indicates that AhR antagonistic activities are significantly enhanced in real mixtures.

TH299 Ecotoxicity of biofuel-mixture DnBe and 1-Octanol on aquatic organisms Dianio rerio and Daphnia magna M.D. Isser, Institute for Environmental Research RWTH Aachen; S. Heger, Institute for Environmental Research, RWTH / Institute for Environmental Research; M. Du, Institute for Environmental Research, RWTH / Aachen / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics. The worldwide demand for fuels is increasing, but currently used fuels are based on fossil resources. A possible alternative for diesel is the biofuel mixture of 1-Octanol (1-Oct) (80%) and Dn-n-butyl ether (DnBe) (20%). These fuels are based on the raw material lignocellulose and/or micro-algae. However, the effects of this mixture indicate a high risk of environmental contamination, especially for aquatic ecosystems. This study focuses on the ecotoxicological evaluation of this mixture and the investigation on a possible interaction of the two substances. Acute embryotoxic and developmental effects were investigated in the fish embryo toxicity test (FET) with Danio rerio (OECD 236). The acute immobilization assay (OECD 202) was performed to determine the LC50 value of this mixture. To interpret the results for possible interactions between the two substances, the interaction of DnBe and 1-Octanol as single substances was necessary. In the acute immobilization test, the EC50 values were 14.7 mg/L for 1-octanol and 17.3 mg/L for DnBe. Both biofuels led to teratogenic and lethal effects in the FET (LC50: dnb: 24.7 mg/L; LC50: oct: 11.3 mg/L). Especially in the study of DnBe was a low hatching rate, while edemas were often observed at the pericardium of the developing larvae. Testing the mixture in the FET revealed a LC50 of 14.7 mg/L. The acute immobilization test resulted in a EC50 of 25.6 mg/L. The determined EC50/LC50 values in both bioassays suggest an additive mode of action of the compounds. The comparison of the determined values with data of other biofuels (2-methylfuran, 2-methyltetrahydrofuran) showed a higher toxicity of the mixture. DnBe show a higher toxicity on D. magna than the tested mixture. For the comprehensive ecotoxicological assessment of the mixture and the compounds as single substances further tests are required. Especially regarding to the possible impairment of the hatching of D. rerio. Preventing of slippage can cause the larva to be no longer viable, resulting in a misinterpretation of the detected LC50. In future, further ecotoxicologically relevant endpoints should be investigated. This work was performed as part of the research project “Tailor made fuels from “biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

TH300 Single and combined effects of propiconazole and ZnO (bulk and nano form) on various biomarkers and reproduction in Euphyraea albida N. Ćurčić, . Lonńarḯ , University of Osijek / Department of Biology; D. Hackenberger, Department f Biology, University of Osijek / Department of Biology; L. ZeliDŽ, University of Osijek / Department of Biology; N. Ćurčić, . Hackenberger, Department f Biology, University of Osijek / Department of Biology; B. Hackenberger, Department f Biology, University of Osijek / Department of Biology. Single and combined effects of propiconazole and ZnO (bulk and nano form) have been recognised as an emerging contaminants over the last decade. However, the majority of research have dealt with the effect of a nanoparticle as a single stressor. In this study we have investigated whether a combination of fungicide (propiconazole - PCZ) and nanoparticle (Zn oxide - ZnO) have different effect on oxidative stress and reproduction of Euphyraea albidaus than each of these compounds applied separately. Propiconazole was tested as a commercial formulation and ZnO was tested and used in a nano and bulk form. In a preliminary experiment an EC50 value for reproduction for each compound was calculated (480 mg/kg ZnO and 40 ug/g PCZ). In the second experiment ecotoxicologists were exposed to five concentrations in following ratios: 100% PCZ, 75% PCZ/25% ZnO, 50% PCZ/50% ZnO, 25% PCZ/75% ZnO, 100% ZnO, which are an EC50 value. The time of exposure in both experiments was 21 days after which adult enchytraeids were removed from soil, following another 21 days for juveniles to hatch, according to OECD protocol. Adult enchytraeids were used for subsequent measurement of biomarkers of oxidative stress (AChE, CAT, GST) and metallothioninen content. The results showed a slightly different response of measured biomarkers to ZnO than to a ZnO in both single exposure and when combined with propiconazole as well as the effect on reproduction.

TH301 Mixotrophy of abamectin and difenoconazole to zebrafish embryos (Danio rerio) A. Madeira Sanches, University of Sao Paulo - USP / Núcleo de Ecotoxicologia e Estudos Ambientais NEEA; E. Freitas, University of Sao Paulo - USP / Hydraulic and Sanitation; I. Dominges, University of Aveiro / CESAM Department of Biology; M. Daam, CENSE & New University of Lisbon, Lisboa; L.P. Figueiredo, University of Sao Paulo USP; E. Espindola, University of Sao Paulo - USP / Hydraulic and Sanitation. There are many agrochemicals used in agriculture, among them the insecticide abamectin and the fungicide difenoconazole. They are widely used compounds in strawberry crops in regions of tropical climate, although they are compounds classified as extremely toxic and very dangerous to the environment. The use of fish as test organisms stands out in ecotoxicology due to its representativeness and critical role in aquatic environment. Due to ethical issues and to reduce costs, space and waste generated, alternative methods such as assays using fish embryos are currently widely used. The FET - Fish Embryo Toxicity Test is an example of a standardized test that use Danio rerio embryos. Considering the ecological risks
inherent to the use of the insecticide abamectin and the fungicide difenoconazole, the main objective of this research was to evaluate the effect generated in Danio rerio embryos exposed to pesticide mixtures and evaluate the effects produced by the interaction of these compounds. For this, Danio rerio embryos were exposed for 96h to the binary mixtures of abamectin and difenoconazole following the recommendations of OECD TG 236. The concentrations used were 0.5; 1; 1.2; 2.4; 5.3 and 11.7 mg L⁻¹ of abamectin and 0.2; 0.5; 1; 2.3 and 5.0 mg L⁻¹ of difenoconazole. The factorial design was used combining all possible concentrations, and in total 35 treatments plus the control were performed. The exposures were performed in 50 mm Petri dishes using three plates per treatment. In each plate containing 15 mL of solution were arranged 5 eggs totaling an n = 15. Survival data were recorded every 24 hours and the results were analyzed in the Mixtox assay, which assumes that the binary interactions of abamectin and difenoconazole promotes in Danio rerio embryos the antagonistic effect in the lower concentrations, but in higher concentrations the produced effect is synergic. This means that, at lower concentrations the interaction of abamectin + difenoconazole seems to decrease the toxicity of pesticides to Danio rerio embryos, but the toxicity of the compounds is potentiated at higher concentrations of the mixture. Similar results were obtained in other studies with organisms exposed to mixtures of these same compounds, but complementary studies are necessary to better understand the toxicokinetic of these pesticides mixtures.

### TH302

**Cocktail effect of persistent organic pollutants on selected bioreporter-systems and zebrafish embryos**

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There is an ever-increasing number of chemicals including pharmaceuticals and industrial pollutants that are released into the aquatic environment, leading to the exposure of fish and other aquatic organisms. Moreover, at the present time environmental risk assessment is mainly based on chemical analysis, only. However, “compound-by-compound” based assessments seriously run the risk of underestimating the risk of chemicals as the true exposure scenario for humans and wildlife is known to be far more complex. Under regular environmental conditions organisms can be exposed to multiple chemicals associated with different risks and specific effects, e.g. teratogenicity, immune toxicity and suppression, genotoxicity, and endocrine disruption. Moreover, it has been repeatedly demonstrated that pollutants and the underlying toxic responses may interact and generate effects that are different from the toxicity of the individual chemicals. Thus, understanding the effects of similar mixtures, generally referred to as “cocktail effects”, represents one of today’s greatest challenges in environmental but also in human toxicology. The aim of the present study is to investigate embryotoxic and teratogenic, but also mechanism-specific effects using zebrafish embryos. They will be exposed to selected priority pollutants and their mixtures (e.g. polychlorinated biphenyls, heavy metals, polycyclic aromatic compound). These chemicals represent highly relevant chemicals which can be found in great levels in the environment. First results indicate that beside biological interactions heavy metals may alter the toxicity of organic pollutants. This study is part of the EnForce project (https://www.oru.se/enforce), which aims at the development of an effect-based risk assessment in cooperation with different stakeholders and several industrial partners.

### Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking (P)

**TH304**

**Environmental impact assessment of carbon fibers reinforced composites: pyrolysis process**


The end-of-life management of carbon fibers reinforced composites (CFRCs) has been investigated by comparing the environmental sustainability of Curti S.p.A. company’s pyrolysis process with waste-to-energy (WtE) and landfill disposal. The determination of environmental loads was carried out through the Life Cycle Assessment (LCA) methodology, modeling and analyzing each scenario through the use of SimaPro and Eco Invent database. CFRCs are highly engineered materials, with high calorific power and excellent mechanical properties. From their recovery, it is possible to obtain a secondary raw material that can be used in application requiring lower performance than originals, or the recovery of thermal/electrical energy. The market still offers few CFRC recovery technologies. Therefore the most developed ones have been chosen to compare with landfill disposal, even though nowadays it would be avoided, for waste with a LHV+13 MJ/kg [1]. The pyrolysis process involves a first pyrolysis and a subsequent gasification of the waste within the same reactor. This system allows the quantitative recovery of carbon fibers (CF) contained in the initial composite and generates hot gaseous compounds that are burnt and released into the atmosphere. Since the plant is at a pilot scale, a heat recovery system has not been designed yet for the combustion of fumes. Considering the impact assessment results, pyrolysis has proved to be the most sustainable treatment due to the quantitative recovery of carbon fibers, which avoids the consumption of material and energy deriving from the production of virgin carbon fibers. The worst scenario is WtE, mostly due to damaging effects generated by emissions in air and water. The impact of landfill disposal is intermediate, due to the good stability of CFRCs: a slow degradation, their disposal in landfills does not cause an high impact, except for land occupation. The LCA study made it possible to carry out a preliminary assessment supporting the pyrolysis pilot plant design, to identify critical aspects and strengths of each scenarios. [1] Legislative Decree n°36 of 13 January 2003; Implementation of Directive 1999/31/EC on landfill of waste, Official Journal of the Italian Republic, 2003. [2] Legislative Decree n°205 of 3 December 2010; provisions implementing Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste, Official Journal, 2010.

**TH305**

**Critical raw materials in a new building integrated photovoltaic system**

D. Garaia, I. Herrera, Y. Lechón, CIEMAT / Energy Dpt Energy Systems Analysis Unit

REELCOOP, an EU-FP7 funded project which stands for REnewable ELectricity COoperating photovoltaic (PV) ventilated façade (6kW) and involves the development of c-Si solar cells, as well as the study of the ventilation effect in PV façades. PV solar panels have particular metals or rare earths that are potentially included in the category of ‘critical raw materials (CRMs)’. This work aims to identify the potential CRMs in this prototype and to define several ways to improve the sustainability from a life-cycle approach, including aspects like substitution or recycling of these materials.

**TH306**

**Environmental sustainability assessment of a biological Active Pharmaceutical Ingredient: A resource based Life Cycle Assessment**

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Most Life Cycle Assessments (LCAs) performed in the pharmaceutical sector have been done on chemically synthesized drugs, leaving biopharmaceuticals aside. The fact that sustainability assessments of biopharmaceutical products and technologies have been rarely done is probably a consequence of the major challenge that building a robust Life Cycle Inventory (LCI) represents for the upstream and downstream processes of biologics. However, the low number of LCAs performed on biopharmaceuticals does not reflect the current reality of the pharmaceutical sector, as its market is rapidly growing at an annual rate of around 9%. Therefore, this study focuses in performing a resource based LCA to measure the environmental impact of a biological Active Pharmaceutical Ingredient (API). A resource based methodology was used to address the task that addressed in a focus on supply and efficient use of resources. The API investigated is infliximab, a monoclonal antibody that treats autoimmune diseases. An Exergetic Life Cycle Assessment (ELCA) was conducted, using the Cumulative Exergy Extracted from the Natural Environment (CEENE) method. First results show that the unit operations with the highest impact are: i) The first chromatographic process for purification (Direct Product Capture), since it requires the highest quantity of buffers which are produced using chemicals as well as complex organic compounds such as amino acids. ii) Fermentation, as similar complex components are required for its medium, which are also produced through biotechnological processes. Furthermore, fermentation is the process that takes the longest (several days), leveraging the Heating Ventrilation and Air Conditioning (HVAC) system to achieve the clean room conditions needed for the production of biologics. HVAC has shown to be the utility with the highest impact, consuming a significant percentage of the total electricity used in the plant. Performing an LCA on a biologic mainly using primary data has been proven to be a possible task. However, challenges such as the data unavailability of biotechnologies used to produce the nutrients needed throughout the process, as well as the further integration of these technologies into databases should be addressed.

### TH307

**LCA methodology: a case study of the industrial production of terephthalic acid from renewable sources**

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Continuous micro/milli-flow (CF) synthesis is considered to be the natural evolution of the currently most diffused conventional batch synthesis, as it intensifies the production in terms of productivity, energy and chemicals use, product quality and functionalisation. Given the importance and potentiality of the transition, an evaluation of these new technologies is needed. Life Cycle Assessment is the chosen methodology for addressing this obj ective, as it looks deep into the sustainability, efficiency and environmental impact of the system considered, in order to identify the key parameters for a deliberate green process design. The application of the LCA methodology to ENPs production presents many challenges: to date, few LCA studies within the manufacturing process of ENPs have been carried out. In this work, a wide selection of ENPs production is modelled and analysed, considering substances like SiO2, CuO and AuNPs. The CF syntheses are evaluated on a lab scale, performing a hot-spot analysis and benchmarking them against the equivalent batch syntheses. The output of the assessment permits valuable considerations on the best equipment materials, solvents, stabilizers, type of heating and mixing for maximising the efficiency of the process, even at the very early stages of its development. The results obtained highlight a general favourable tendency toward the CF system as a greener and more efficient way of ENPs synthesis than the correspondent batch production.
High-operating-temperature thermal storage materials for TES increasing up to 3 times the thermal capacity. All these solutions are being assessed through a comprehensive LCA, considering the entire life cycle of materials and components, from raw material extraction until the end-of-life. A comparative analysis is being prepared between baseline scenario (with reference materials) and the scenario with the IN-POWER innovative materials. Along the project different candidate materials, and approaches are being assessed. A design of experiments process looking for high performance materials but environmentally friendly. Some improvements are being made such as: use of aluminum instead of silver in the mirror reflective coating, to meet the European requirements for use of non-critical materials; the reduction of materials weight; and the increase in materials robustness. The expected results are to: Obtain a complete environmental profile of IN-POWER CSP architecture. Calculate the environmental impacts associated to: new polymeric materials for mirrors; high absorber coating; high thermal storage capacity materials; polymeric composite for CSP structure. Evaluate the benefits of IN-POWER materials compared with reference materials. Evaluate the benefits of IN-POWER CSP architecture compared with current mature Parabolic Trough Collector technology.

TH312 Environmental impact and social influence of an Advanced Adiabatic Compressed Air Energy Storage (AA-CAES) located in Eisenerz, Austria. The case of RICAS2020 PROJECT. A. Claret, Leitat Technological Center / Sustainability Division; G. Ferrer, Leitat Technology; Quantitat Ge en / RD Sahite; and social impacts and benefits of AA-CAES, compared to current energy storage technologies: Pumped Hydroelectric Energy Storage and Batteries. - Identify which of the candidate materials involved in the construction of the Cavern and TES have the most suitable environmental profile. Preliminary results of the environmental LCA of candidate materials for TES have been obtained so far. 12 scenarios have been generated, by combining 3 construction technologies (in the excavation stage) and 4 different storage materials (rocks from the excavation site, gravel, alumina or silica ceramic spheres). Results have shown that worst cases are the scenarios that include alumina ceramic spheres as storage material, due to the high impact of aluminium oxide. The best scenario is the use of rocks from the excavation site without including structural material.

TH313 Upgrading wastewater treatment technologies in the framework of current renewable energy policies - an environmental assessment A. Petit-Boix, University of Freiburg / Chair of Societal Transition and Circular Economy; M. Riba-Salas, Universitat Autònoma de Barcelona / Institute for Environmental Science and Technology (ICTA); G. Villalba, X. Gabarrull, J. Rieradevall, Universitat Autònoma de Barcelona / Institute of Environmental Science and Technology & Department of Chemical, Biological and Environmental Engineering; E. Moliné, Depuración de Aguas del Mediterráneo; M. Suárez-Ojeda, Universitat Autònoma de Barcelona / Department of Chemical, Biological and Environmental Engineering. A large number of wastewater treatment plants (WWTP) use anaerobic digestion to treat surplus sewage sludge, which produces methane-rich biogas. This biogas can be used for cogeneration with the ultimate goal of turning WWTPs into energy self-sufficient facilities. For this reason, current innovation projects focus on (i) improving the energy efficiency of the plant and (ii) updating the technologies used in the current WWTPs or proposing new processes that increase biogas production. However, we need to clearly define whether these technological updates and innovations result in net environmental benefits or generate tradeoffs. Here, renewable energy policies should align with the environmental goals of energy self-supply in order not to discourage the investment in this type of infrastructure and its potential environmental benefits. Thus, we question whether upgraded or new wastewater treatment technologies generate larger environmental impacts when renewable energy policies are not favorable to the self-supply of energy through cogeneration. In this case, our study focuses on a conventional WWTP in the city of Rubí (Barcelona), which currently only removes organic matter. This facility considers an upgrade that consists in a new wastewater treatment scheme, i.e., (i) a first stage of biodegraded enhanced biological phosphorus removal, (ii) a second stage of autotrophic biological nitrogen removal in two-steps. A life cycle assessment will determine the environmental impacts and benefits of this upgraded system with respect to the conventional setup. Policy tradeoffs will also be assessed. This wastewater treatment plant originally benefited from cogeneration, but eventually decided to use biogas flare systems due to the taxes on self-supply of electricity imposed by the Royal Decree 900/2015 approved by the Spanish Parliament. As a result, we need to determine if applying technologies that generate more biogas will result in larger impacts than the current scenario if the biogas cannot be used for cogeneration.

TH314 Anticipatory life cycle assessment of sol-gel derived anti-reflective coating for greenhouse glass N. Tsao, CML Leiden University / CML; J. Quist, Delft University of Technology / Technology, Policy, and Management; A. Wypkema, M. Mourad, TNO / Materials Solutions; V. Prado, CML Leiden University. A study of an innovative coating for greenhouse development but at the same time it can cause unfavorable consequences to environment and society. Environmental assessment of the technologies is usually performed when they have already been launched in the market with a low possibility to transform their development towards better environmental performance. Anticipatory Life Cycle Assessment (LCA) has been evolved to assess the environmental impacts of the technological innovations and to predict the impact of the innovation at a future stage. In this case, we present the application of Anticipatory LCA in the assessment of the anti-reflective greenhouse glass coatings. The light intensity is essential for the crop growth in the greenhouses. A portion of the light is lost when it reaches the greenhouse glass surface due to the glass reflection. The anti-reflective glass coatings can be applied on the surface of the greenhouse glass to allow more sunlight to enter the greenhouses. As a result, more yield of crop could be obtained under coated glass. The Netherlands Organization for Applied Scientific Research (TNO) is developing a novel anti-reflective coating for greenhouses which is expected to have higher light transmittance than the conventional coatings by 2.5%. In this study, three reference coatings in addition to the novel coating were assessed. The functional unit was the mass of tomatoes obtained under a certain area of a greenhouse with uncoated/coated glass during 30 years. The novel coating is being synthesized in the laboratory scale, and thus, in LCA, What-if scenarios were used to scale-up the coating system to pilot and industrial scales. The laboratory parameters, e.g. the amount of electricity used to produce the coating and the solution volumes, were optimized using literature and expert consultation. The comparative analysis and sensitivity analysis showed that electricity used for the production of glass has higher impacts than transmittance or degradation time of the coatings.

TH315 Combine process simulation analysis with Life Cycle Assessment method in polyurethane rigid foam production A. Bordignon, M. Fermeglia, Università di Trieste; A. Bortoluzzi, S. Rondinini, C. Locatelli, A. Vertova, Università di Milano. Process simulation is a computational technique used in several sectors of process engineering. It is very useful at design stage, for defining the feasibility of a new process, as well as in the process optimization stage, where the optimum value of the production is pursued and, last but not least, in the process analysis stage for understanding the potential improvement of an existing process. It consists in the construction of a simulation model by combining data obtained from experimental experiences and the physics of the process as well as the material and energy balances of the unit operations involved. The Life Cycle Assessment is a methodology aiming at analysing the overall life cycle of products, processes or service. In this work, we present the analysis of the complete life cycle of polyurethane rigid foam from cradle to grave in tight connection with process simulation methods, thus taking the characteristics of the conventional processes, such as pressure drop, energy consumption and other, with impact assessment. This combination will allow us to identify the best solution for the production of polyurethane rigid foam both in terms of end of life scenarios and environmental impact.

TH316 Life Cycle Assessment of CO2-based Methanol Production using Captured CO2 from Fossil Fuel Power Plants C. Lee, University College London / Department of Chemical Engineering; R.
Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach (P)

TH317 Linking failed swim bladder inflation of larval Japanese medaka (Oryzias latipes) after embryonic exposure to 17α-ethinylestradiol, levonorgestrel and diclofenac, to disturbed type-I/V1 voltage-gated, sodium-specific calcium channel signalling. Z. P. Pandelides, University of Ontario Institute of Technology; M. Overturf, University of Louisiana at Monroe / Biology; E. Ussery, University of Ontario Institute of Technology / Biological Sciences; J. Guichard, University of Ontario Institute of Technology / Faculty of Science, Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Faculty of Science, Aquatic Toxicology

TH318 Linking mode of action of the model respiratory and photosynthetic uncoupler 3,5-dichlorophenol to adverse outcomes in Lemma minor L. Xie, NIVA - Norwegian Institute for Water Research; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; K. Solhaug, Norwegian University of Life Sciences; Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; J. Moe, NIVA Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Lemma minor is an aquatic plant commonly used in laboratory phytotoxicity testing due to its rapid reproduction capacity, resource-effective exposure format and central function in the aquatic ecosystem. Several standard methods have already been adopted by international standardisations organizations using this species as an ecotoxicological model. Although being highly useful for regulatory purposes focusing on traditional and emerging pollutants, these tests are often unable to provide information about the toxic mechanisms and modes of action (MoA) and rarely address complex environmental issues such as exposure to multiple stressors. The present study aimed to use selected functional assays in L. minor after exposure to 3,5-dichlorophenol (3,5-DCP) as a model to characterize the toxic mechanisms causing growth inhibition and lethality in primary plant cells. The results demonstrated that 3,5-DCP caused concentration-dependent effects in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation (OXPHOS), chlorophyll content, reproduction rate and frond size are more sensitive to 3,5-DCP compared to other responses as well as reactive oxygen species (ROS) formation, lipid peroxidation (LPO) and impairment of photosynthesis efficiency. Principal component analysis (PCA) indicated that suppression of photosystem II (PS II) efficiency, electron transport rate (ETR), ROS production and LPO, pigments content and growth were strongly correlated while inhibition of oxidative phosphorylation (OXPHOS) which was more closely correlated with growth parameters. A set of conceptual Adverse Outcome Pathways (AOPs) were developed by using Bayesian network model to decipher the causal relation well studied in vertebrates, especially mammalian species. However, for other ecologically relevant environmental species, such as aquatic invertebrates, the knowledge is still limited. The present study was therefore conducted to: develop AOPs for ROS-mediated reproductive effects in aquatic invertebrates based on existing data from the literature; assess the weight of evidence (WoE) of the AOPs for ROS-mediated effects in aquatic invertebrates, and metals, ionizing radiations as prototypical stressors. A network of conceptual AOPs was assembled first and a linear AOP with the strongest data support was then selected prior to WoE assessment using the Evolved Bradford Hill considerations. The laboratory evaluations of the AOPs were performed using UVB and gamma radiations as prototypical oxidative stressors. Daphnia magna was used as the model species. The laboratory studies clearly showed that both UVB and gamma radiation caused dose-dependent reduction in reproduction after the exposure. The reproductive effects were correlated with excessive ROS production, lipid peroxidation, DNA damage, apoptosis, mitochondrial membrane potential, LDH leakage, potential lipid storage, and abnormal ovary structures and oogenesis in D. magna, thus verifying several KEs in the conceptual AOPs. This study has for the first time systematically linked excessive ROS production to reproductive effects in aquatic invertebrates using the AOP concept, thus providing mechanistic knowledge for future hazard and risk assessment of oxidative stressor-mediated adverse effects in ecologically relevant species.

TH320 Development of an Adverse Outcome Pathway for cardiotoxicity mediated by the blockade of L-type calcium channels L. Margiotta-Casaluci, H. Dusza, I. Moreira, Brunel University London / Institute of Environment, Health and Societies; M.J. Winter, The University of Exeter / Centre for Environment and Lifelong Education; H. Prior, National Centre for the Replacement, Refinement and Reduction of Animals in Research (NCR3s)

A diverse set of chemical compounds, including some pharmaceuticals and
insecticides, have the potential to perturbate the functionality of calcium channels. Among the different types of calcium channels, the L-type calcium channel (LTCC) is responsible for the excitation-contraction coupling of skeletal, smooth, and cardiac muscle. Chemicals that unintentionally block this channel in cardiac cells may impair heart function and health, leading to various cardiac pathologies and predisposing individuals to heart failure. Advancing our understanding of the molecular mechanisms underlying these adverse effects is of paramount importance if we want to develop effective strategies able to accurately predict the cardiac risk posed by chronic exposure to those chemicals. In this presentation, we describe the development of an Adverse Outcome Pathway (AOP) that outlines the series of causally related key events triggered by the blockade of LTCC, and that can ultimately lead to cardiac adverse effects. We discuss the integration of in silico, in vitro, and in vivo evidence in the AOP development, as well as the application of computational and network biology approaches that may accelerate the identification of relevant key events. Considering the multifaceted role of LTCC in different components of the cardiovascular system other than the heart, we also discuss the importance of applying AOP network considerations to guide a reliable and fit-for-purpose AOP development. This AOP will represent a valuable knowledge base able to guide the identification of key events that are highly predictive of in vivo toxicity, and that can be measured in vitro without relying on animal testing. The knowledge base will also be used as platform to drive future development projects aimed at incorporating additional layers of complexity in the model, and at driving the transition towards a fully quantitative AOP able to effectively support regulatory decision-making and risk assessment.

TH321 Quantification of AOP by Bayesian network modelling: linking 3,5-DCP exposure to adverse outcomes in Lemma minor

J. Mog, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; W.G. Landis, Western Washington University / Institute of Toxicology and Environmental Toxicology; L. Xie, NIVA - Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

AOPs has gained international recognition as a systematic approach for capturing existing toxicological knowledge to transparently link mechanistic data to toxicity endpoints. Nevertheless, most AOPs are qualitative and not directly suitable for quantitative risk assessment. Quantitative AOPs (qAOP) should define the relationships underlying transition from one KE to the next sufficiently well to allow quantitative prediction of the probability or severity of the AO occurring for a given activation of the MIE. We have started developing a Bayesian Network (BN) model to quantify a recently proposed AOP, which links the mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol (DCP) to adverse outcomes in the aquatic plant Lemma minor. The BN model is based on data from a laboratory experiment exposing L. minor to DCP in 8 concentrations with 3 replicates. The measured response variables include OXPHOS (oxidative phosphorylation), ROS (reactive oxygen species), ETR (electron transfer rate), Fv/Fm (maximum quantum yield of photosystem II), LPO (lipid peroxidation) and number of fronds (leaves). The proposed AOPs a network consisting of three chains with the same chemical stressor (DCP) and AO (fronds number). All AOP components are defined in the BN as nodes with discrete states. Each node is quantified by a probability distribution across these states. The causal links (Key Event Relationships) are quantified as conditional probability tables (CPTs), which determine the probability distribution of a child node conditionally on the probability distribution of the parent node(s). The CPTs are calculated directly from the data in this BN version. The BN was run by changing DCP concentration and inspecting the changes in all subsequent nodes. Qualitatively, the model predictions were as expected: increasing the DCP concentration caused reduced OXPHOS, reduced ETR and reduced fronds number. For example, when DCP was increased from 1 to 2 mg/L, the probability of fronds number being in the lowest (worst) state increased from 6% to 30%. Fine-tuning of the intervals of some nodes is needed to make the BN more responsive. Moreover, we will use statistical approaches to obtain more credible CPTs, such as estimation of dose-response curves with uncertainty. Other planned developments include linking the AO to an endpoint with regulatory relevance, and linking the chemical stressor to an Aggregate Exposure Pathway.

TH322 Development of Quantitative Adverse Outcome Pathway (AOP) of Pulmonary Fibrosis with Effecttopedia

J. Jeong, University of Seoul; J. Choi, University of Seoul / School of Engineering; S. Choi, University of Seoul / Environmental Engineering; J. Choi, University of Seoul / School of Environmental Engineering.

Pulmonary fibrosis (PF) is a chronic and progressive lung disease where the scars are formed in the lung tissues and the air sac in the lungs (alveoli) becomes stiff leading to serious breathing problems. Several substances are identified as inducer of PF, but high cost of inhalation toxicity studies refrain to conduct systemic studies of all those substances. Hence, the regulations of these substances become obscure. To solve this problem, Adverse Outcome Pathway (AOP) concept has been emerged. AOP is a framework that organizes existing knowledge about linkage between molecular-level perturbation and an adverse outcome. To facilitate the development of AOP, OECD launches AOP knowledge-base (KB). In recent years,
Fish model species in human and environmental toxicology (PC)

**MOPC01**  
Fish caging experiment as a tool for in situ assessment of neurotoxic effects of untreated wastewaters  
B. Micic, Petnica Science Center/Faculty of Sciences, University of Novi Sad / Department of Biology and Ecology; D. Tenjic, University of Novi Sad Faculty of Sciences / Biology and Ecology; S. Sipos, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology; V. Knezevic, Faculty of Sciences / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX; S. Kaisarevic, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX); I. Teodorovic, University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX)

In the framework of FP7 project Solutions, the city of Novi Sad has been selected as a pollution hot spot of the River Danube, mainly due to the direct discharge of untreated sewage into the river. Significant biological effects of untreated sewage were previously observed through an *in vitro* study. To study neurotoxic effects more in details and in realistic ecological context, we conducted fish caging experiment. Common carp (*Cyprinus carpio* (L.), *Cyprinidae*) has been selected for the experiment, as one of the most common species in the Middle Danube, genetically well described and ecologically important. Ten fish per cage were exposed in cages for nine days at three sites on the Danube River: upstream from sewage discharge – reference site, 230 m and 7 km downstream from the discharge and at one site on Sava River (downstream from industrial wastewater discharge near the city of Sabac). After the exposure period, brains were isolated and prepared for gene expression and enzyme activity analyses. The expression of gene encoding for five proteins was studied: tachykinin 3α and tachykinin 3β (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (responsible for myelination of axons and neuroprotection), the activity of acetylcholine esterase (enzyme that terminates action potential transmission in chemical synapses of cholinergic type, was also examined. A trend of slight upregulation for the expression of the genes encoding for tachykinin 3α and tachykinin 3β, GABA a1 receptor and synaptotagmin 10 was observed for all three studied sites when compared to the reference site. The expression of the gene encoding for myelin basic protein was similar at reference site and 230 m downstream from the sewage dischare, but this gene expression was significantly downregulated downstream from the industrial wastewater discharges. Based on this result, myelin basic protein might be potential selective biomarker which can be used to differentiate the effects of these two types of chemical pressure. No significant difference was observed in the activity of the acetylcholine esterase between studied sites. The study is part of the SOLUTIONS project, funded by the EU FP 7 (FP7-ENV-2013-two-stage Collaborative project) under grant agreement number 603473.

**MOPC02**  
Toxicity analysis of treated sugar cane vinasse by integrated systems using gills of Oreochromis niloticus as model  
A. Marques, Sao Paulo State University - UNESP / Department of Biology; C.P. de Souza, Sao Paulo State University - UNESP / Biology; J. Evangelista Correia, Unesp - Institute of Biology / Biology; C.S. Fontanetti, Sao Paulo State University - UNESP / Biology

The alcoholic fermentation of sugar cane (*Saccharum sp.*) results in a by-product known as vinasse. This by-product is used as fertilizer because of its richness in organic matter, and also because it promotes improvement in soil fertility, favoring the availability of some elements for the plants. However, the amount of vinasse used in the fertilization should not overcome the ion retention capacity of the soil, since the dosages should be directed to the specific characteristics of each soil. When used in unbalanced proportions can impair to the soils and the plants, in addition to being able to reach water resources. Considering studies that prove the toxicity of vinasse *in natura*, the use of treatment systems has become quite interesting. The integration of systems such as natural attenuation, filtration and phytoremediation increase the effectiveness of the treatment, since they are highly effective biogeochemical systems to treat waste water from different sources. Aquatic macrophytes, which not only accumulate pollutants directly in their tissues but also produce detoxification enzymes for detoxification reactions that usually, occur in the rhizosphere of plants, they are part of the alternative treatment for vinasse. Fish are excellent experimental models for aquatic toxicity studies because they warn of the potential danger of chemicals reaching water resources. Therefore, this study aimed to verify the efficacy of sugar cane vinasse treatment in reducing its toxic potential by histological and histochemical tests on tilapia gills. The animals were submitted to two different dilutions of the treated vinasse for 96 hours; after this period the gills were removed and submitted to standard histological routine. Morphological analyses of the gills revealed that the cellular pattern described for the species was not altered and histochemical tests showed a decrease on number of mucous cells, thus attesting to the decrease on toxicity of the treated vinasse. Thus, it can be inferred that integrated treatment systems were effective in reducing the polluting potential of vinasse, since the animals did not present histological changes.

**MOPC03**  
Assessing toxic effects in the fish Violet Goby (*Gobioideus broussonetii - Gobiidae*) from one of the most productive estuaries in Brazil  
L. Salgado, Universidade Federal do Paraná / Farmacologia; A.M. Maques, UFPR / Genetics; F. Garrido de Oliveira, UFPR / Pharmacology; S.L. Moretto, M.M. Cestari, UFPR / Genetics; H. Silva de Assis, UFPR / Pharmacology

The Santos-Lagoa da Conceição (Sao Paulo, Brazil) is among the most productive areas in the South Atlantic. The Ribeira de Iguape River (RIR) is the major freshwater contributor of the estuary. It carries different classes of contaminants from former mining activities, agricultural areas and urban centers through an artificial channel. The disordered human occupation, presence of boats and the disposal of waste and sewage are also sources of pollution throughout this system. The Violet Goby (*Gobioideus broussonetii - Gobiidae*) is a demersal fish of a social and economic importance to traditional fisheries. Over the last decade the regional disappearance of this fish species has been reported, including events of high mortality. The contamination by the RIR has been referred as one of the causes of the decline of that population. Therefore, this study aimed to observe possible toxic effects in *G. broussonetii* the studied area. Fishes were sampled from Petnica, Subaúma and Iguape in winter (2016) and summer (2017). The animals were anesthetized, euthanized and the blood, brain, muscle, liver and kidney were collected for the biochemical and genetic biomarkers analysis. The muscle AChE activities showed similar results among the points and seasons, while cerebral AChE were lower in Subaúma in winter. Hepatic and renal GPx and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxicity in Subaúma and Iguape, with higher liver and blood in summer. In winter, nuclear morphology alterations were identified in erythrocytes more frequently in fishes of Cananéia. The results suggest that contaminants such as metals and HPAs previously reported in the sediments may have been stressing this species. The marked seasonality of the region, which consequently influences the temperature, the rainfall regime and the bioavailability of contaminants may interfere in these responses. No expressive anhropic activity was observed near to Cananéia and Subaúma points. It suggests an influence of the local hydrodynamics by dragging the contaminants of the main sources (RIR and Cananéia city) to these areas once lower impacts were seen in Iguape. This last point is located above the artificial channel in an area of low hydrodynamic. Water and sediment chemical analyses are being performed in the studied points in order to support a better understanding of these responses.

**MOPC04**  
Does ozonation of the Aachen-Soers WWTP improve the water quality in the field? Caging experiments with juvenile rainbow trout and various biomarkers  
Y. Mueller, RWTH Aachen University / Department of Ecosystem Analysis ESA; T. Rosenberger, RWTH Aachen University / Institute for Environmental Research BioV; S. Schiwy, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research

The Violet River (Violettalsuppe) is a productive river with high biological state of all surface waters until 2015. However, the good biological state is only reached by around 20 % of the German surface water bodies. One reason might be the release of a variety of anthropogenic contaminants by waste water treatment plants (WWTPs) into these water bodies. Additionally, these substances are not sufficiently eliminated via conventional waste water cleaning processes. Nevertheless, these chemicals can have adverse effects on the river biota. The implementation of a further treatment step into WWTP could reduce this burden. There are advanced treatment processes, as the ozonation. At the “Aachen Soers” WWTP a large scale ozonation plant was installed at the end of 2017. Regular operation will start by approximately March 2018. The “Aachen Soers” WWTP is located at the city of Aachen, near the River Rur (North Rhine-Westphalia, Germany) and releases its effluent to the Stream Wurm. At medium and low water levels the stream runs around 70 % treated waste water. To elucidate the impact of the additional waste water treatment on this river the *status quo* was recorded before the implementation of this treatment step. After the installation of the ozonation the WWTP as well as the Wurm will be monitored for two years. Besides numerous in *vitro* and in *vivo* experiments also in *situ* experiments are conducted with juvenile rainbow trout (*Oncorhynchus mykiss*) were performed upstream and downstream the WWTP. The goal was to evaluate the impact of the WWTP outlet on the river. Further, the impact of the upstream burden was part of the study. Several biomarkers were investigated on different organs of the fish. Detoxification enzymes were investigated in liver tissue and acetylcholinesterase was measured in brain tissue. Furthermore, micronuclei formations counted in blood smears to get information on genotoxic effects. To gain information on endocrine effects Vitellogenin levels were measured in blood plasma and mucus to compare the conventional invasive method with a new non-invasive method. Fish were caged.
MOPC05

Environmental applications for medium-throughput, in vivo androgen disruptor identification with the RADAR assay
A. Tindall, A. Phan, N. Roxane, Watchfrog S.A.; B.A. Demeneix, MNHN / CNRS UMR 7221; G.F. Lemkine, Watchfrog S.A.

Over recent years, it has become evident that environmental contamination with endocrine disruptors is not limited to those acting on the estrogen axis. In contrast, larval exposure of aquatic species to endocrine disruptors has been identified with in vivo models. Two key studies identified 66/200 and 37/134 pesticides tested as anti-androgenic. However, due to the absence of medium-throughput in vivo assays for androgen axis disruption, the effects of many of these pesticides have yet to be confirmed in vivo. We developed a transgenic medaka line harbouring a portion of the spiggen1 gene promoter driving expression of GFP. We have previously demonstrated that this line is capable of correctly identifying androgens and anti-androgens, including pesticides, with similar sensitivity to the androgenised female stickleback screen but in a greatly reduced time frame. Using eleuthero-embryonic life stages we developed the Rapid Androgen Disruption Adverse outcome Reporter (RADAR) assay. Extracts of Danube River water from sites upstream and downstream from a major effluent stream from the city of Novi Sad in Serbia was analysed. Comparison of our results to previously published data from four in vitro assays carried out on the same extracts indicated that the effect observed in vivo was two orders of magnitude higher than the in vitro effect, suggesting additional mechanism(s) of action present in vivo in addition to androgen receptor activation indicated by the in vitro assays. Application of the RADAR assay for effect-directed analysis was demonstrated for the rapid in vivo confirmation of both known and unknown number of pesticides that had been identified by screening with in vitro models were also tested. The anti-androgenic effects of these pesticides had not previously been confirmed in vivo to our knowledge. Powerful anti-androgenicity was observed with the RADAR assay for some of the tested pesticides, confirming the results of the in vitro study. The RADAR assay is a reliable medium-throughput tool that can be applied within a variety of environmental scenarios in order to identify androgen axis disruption, such as environmental monitoring, identification of unknown toxicity drivers and testing of pure chemicals in a REACH context. In addition, this model, based on the use of early life stages non-compliant with the EU definition of a laboratory animal, provides ethical advantages in line with the three R’s principle of animal replacement.

MOPC06

Evaluation of the toxicity of environmental samples collected near vineyard parcels on rainbow trout larvae (Oncorhynchus mykiss) and liver cell line RTL-W1
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In the last decades, viticulture is one of the most profitable agricultural domains globally. Aquatic ecosystems are usually the final receptacle of all pollutions by leaching, deposition or infiltration; but, because of its capacity of accumulation, sediments represent a reservoir of contaminants larger than the water column itself. The aim of this work was to assess the toxicity of environmental samples, waterborne and sediments, from La Livenne river in hepatic cell lines (RTL-W1) and rainbow trout (Oncorhynchus mykiss) larvae. Samplings were done in La Livenne’s watershed near Bordeaux (Southwestern France), a region with a strong presence of vineyards, over three campaigns in February, May and August 2017. Waterborne and sediment samples were collected in 4 sites from La Livenne (Menanteau, Parodier, Grand Village and Vignolles) and one site Reguignon from Les Souches (a small stream highly impacted by viticulture activity that rejects in La Livenne). Pollutants from 1 L water column had been extracted by SPE (Solid Phase Extraction) method and from sediments had been extracted by elutriates. In the first part of the study, RTL-W1 cells were exposed separately to extracts of water and sediment samples from the three campaigns and different toxicity tests were performed as cytotoxicity (MTT test) and ROS (Reactive Oxygen Species) induction. In the second part of the study, all samples were exposed for 48h to both water and sediment samples collected in May (during spreading season). Different toxicity criteria as viability, biometry and genotoxicity were studied. Waterborne extractions from Grand Village, Vignolles and Reguignon were cytotoxic but at 10 or 20 times the environmental concentration. No ROS production was observed. In the other hand, cells exposed to sediment elutriates were able to induce ROS, but no cytotoxicity was observed. In the case of rainbow trout larvae, no mortality was observed after 48h of exposure. However, differences in biometry was observed on larvae exposed to Menanteau, Grand Village and Reguignon when compared to non-exposed larvae. In particular, the head size was significantly smaller than control larvae, and yokel sac area was bigger in exposed larvae when compared to control larvae. Our study demonstrated that environmental samples of water and sediments collected close to vineyards are toxic in in vitro and in vivo assays on rainbow trout.

New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (PC)

MOPC07

Optimization and Automation of Raman Microspectroscopy for Microplastic Analysis
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On the one hand, plastics are a most important part of our daily life. Due to their versatile properties, especially their low weight, formability and their low costs they are an ideal packaging material.[1] On the other hand, microplastics (MP) in the environment are a growing concern and research efforts need to be addressed. Raman microspectroscopy (RM) is a versatile tool for MP analytics.[2] Optimization and automation of RM measurements as well as automation of spectral data evaluation are of high importance for monitoring programs and enable quantitative results. We advanced RM-based analysis by optimizing measurement parameters, measurement automation and rapid spectral data evaluation. First, a filter holder was constructed that flattens the filter surface. This filter holder is superior compared to filters deposited on, or glued to, glass slides. However, a flat filter surface is only a first step for successful measurements. For an automated particle recognition we also optimized the contrast between particles and filter. To this end, a variety of polymers (e.g. PE, PP, PS) of different sizes (10^-7 – 10^-6 m) and forms (spheres and irregular shapes) were analyzed on different filter materials (e.g. PC, gold coated PC, nitrocellulose, etc.) under different modes of illumination (bright and dark field, fluorescence mode). We found that reflecting filter materials combined with dark field illumination yield superior contrast. Finally, we tested these optimized parameters with samples of different complexity (incl. environmental samples) and three RM measurement modes - semi- and automated in regard of particle recognition and automated spectral data evaluation. Samples with a low loading are accessible via an automated approach, whereas the analysis of more loaded samples is better done with manual particle recognition.[3] The results brought forward in this work aim to catalyse advances towards automated methods for a better assessment of environmental risks arising from MP. In the future, the challenges lie in developing automated methods into these samples, especially for high-pressure samples such as sediments. [1] A.L. Andräy, Mar.Poll.Bull., 2011, 62, 1596-1605 [2] N.P. Ivleva, et al., Angew.Chem.Int.Ed., 2017, 56, 1720-1739 [3] P.M. Anger, et al., in prep. Acknowledgement - The authors thank the German Federal Ministry of Education and Research for funding of the project MiWa and the Raman microspectroscopy alpha 300iR (Witec GmbH).

MOPC08

Preparation of model small microplastics and nanoplastics
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Pollution with plastic debris and plastic fragments has recently been recognized as a major water quality problem in fresh and marine water systems. Degradation of plastic debris in the marine environment leads to the formation of microplastics (< 5mm) and potentially nanoplastics (< 1 µm). Recent investigations show that the microplastics can interact with the marine biota. The impact of the interaction on the exposed organism depends on the nature and size of the particles. To acquire more knowledge on these impacts and to optimize analytical procedures, model particles of different sizes and nature of polymers are necessary. However, in the smallest range (< 10 µm), particles of only a few types of polymers are currently available. For this reason, most toxicity tests were realised using PS beads whereas polyethylene (PE) and polypropylene (PP) fragments are by far the most common in the aquatic environments. In addition, commercial micro and nanobeads have surfactants at their surface which may enhance their toxicity. Here, we present a simple methodology that allows one to prepare small microplastics of PE with sizes between 0.7 µm to 3 µm. These particles were obtained by dissolving PE particles without any surfactant. However, to obtain significant yields it is advantageous of the presented methodology is that it is possible to produce these particles without any surfactant. However, to obtain significant yields it is necessary to add a surfactant. Several types of surfactant were tested (Tween60, Tween80 and a biosurfactant obtained from an algae culture). The effect of each surfactant on the size, shape and stability of the particles will be discussed. These surfactants at their surface which may enhance their toxicity. Here, we present a simple methodology that allows one to prepare small microplastics of PE with sizes between 0.7 µm to 3 µm. These particles were obtained by dissolving PE particles without any surfactant. However, to obtain significant yields it is necessary to add a surfactant. Several types of surfactant were tested (Tween60, Tween80 and a biosurfactant obtained from an algae culture). The effect of each surfactant on the size, shape and stability of the particles will be discussed. These
MOPC09
Effects on humic substances and sediments on the sorption of anthropogenic chemicals to different MP particles
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Plastic products are nowadays omnipresent as they possess excellent characteristics as raw materials. An increased production and usage of plastic products in the last decades led to an emerging pollution of the environment. Slow or no biodegradability of plastics acts as a vector for accumulation of plastic particles in the environment. Plastics can be found in various sizes in the environment, large items were found as well as small particles or debris, which are referred as microplastic (MP) in a size range from 5 mm to 1 µm. In aquatic environments organic pollutants may sorb to MP, which can act as vectors for the sorbed pollutants. It is assumed that polymer material, characteristics of the sorbate, embrittlement of MP-particles, biofouling, and adsorption of surface-wettable components play a role for the sorption. Humic substances are a complex mixture of breakdown products of biologic matter, representing about 50% of dissolved organic in surface waters. The composition and structure of humic substances are not yet fully elucidated due to their heterogeneity. Humic substances contain a high number of electron donors, which can interact with many natural and anthropogenic substances. Sediments consist of inorganic and organic components, which pose alternative sorption sites for dissolved substances. To investigate the effects of humic acids and sediments on the sorption of anthropogenic pollutants, sorption isotherms of i.e. galaxolide to polystyrene (PS) and other synthetic polymers were modelled in presence and absence of humic acids and sediments. A liquid-liquid extraction of the aqueous phase was performed to determine the equilibrium concentrations of galaxolide. A comparison of sorption isotherms regarding the influence of humic acids and sediments was performed to prove or disprove the following hypothesis. (I) Polymer material does not have an impact on sorption in presence of humic substances, due to the sorption of humic substances to the polymer surface. (II) Polymers do not contribute a significant amount to the overall sorption of organic pollutants as majority of them sorbs to sediment which is present in excess. The results of this study should provide a tool for predicting sorption behavior of MPs in environmental freshwater samples. Therefore, different parameters presumably affecting the sorption were investigated or are still under investigation to identify their impact on the sorption of organic pollutants in freshwater systems.

MOPC10
Micronized tire rubber: abundance and distribution within microplastic litter of the Charleston Harbor Estuary, South Carolina, USA
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Microplastics (2µm present on shorelines worldwide. A previous survey of Charleston Harbor, South Carolina, USA reported on average of 591±103 microplastic particles/m² in intertidal sediments, with black fragments suspected to be micronized tire rubber making up >90% of the particles at some sites. The objective of the present study was to further characterize the abundance and distribution of microplastics, and in particular, micronized tire rubber, in an effort to identify the sources and pathways into Charleston Harbor. As rivers are thought to be a contributory source of non-point and point source microplastics, three major tributaries of Charleston Harbor—the Ashley River, Cooper River, and Wando River—were surveyed. Intertidal sediment (n=6), subtidal sediment (n=3), and sea surface microlayer (n=3) samples were collected from three sites (upstream, midstream, downstream) along each of the rivers and were analyzed for microplastics (63-500 µm). Intertidal sediment microplastic abundance ranged from 3-4375 particles/kg wet weight. Sea surface microlayer microplastic abundance ranged from 3-36 particles/L. Microplastic abundance in intertidal sediments and subtidal sediments differed significantly among rivers (p<0.0001 (intertidal), p=0.02 (subtidal)), while microplastic abundance in the sea surface microlayer did not differ significantly among rivers. Blue microplastic fibers and micronized tire rubber were the two most abundant types of microplastics observed, constituting 26.2% and 17.1%, respectively, of total microplastics collected. Furthermore, micronized tire rubber was collected at every sampling location and in every environmental sample type (intertidal sediment, subtidal sediment, sea surface microlayer). These results suggest that microplastics in Charleston Harbor originate primarily from non-point sources and that micronized tire rubber is a significant contributor of microplastic litter in Charleston Harbor. These results are the first to report on the abundance and distribution of micronized tire rubber as microplastic litter in a southeastern U.S. estuary and contribute to the understanding of the worldwide environmental presence of micronized tire rubber.

MOPC11
Crumb rubber in sports fields - Advances in environmental chemistry
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In Norwegian coastal communities, rubber microplastic granules (≤ 5 mm in size) derived from discarded vehicle tires are used in large quantities on outdoor synthetic turf sports pitches. Through transport by waste water effluents and terrestrial runoff, these rubber particles are considered a significant source of MPs to the marine ecosystem. In the here presented interdisciplinary project we study the contributions of degradation and leaching to environmental impacts of these rubber granules from locations in northern Norway and Svalbard. Their persistence and residence time in the Arctic marine environment is unknown. These rubber particles pose a potential health risk for arctic wildlife through direct ingestion, especially at the base of the marine food chain, but may also provide an exposure route for toxic additives present in tires to marine organisms. Furthermore, the rubber particles may act as a vector for other persistent organic and heavy metal pollutants currently present in the marine environment. Arctic marine environments present special abiotic conditions for the degradation of these particles, with cold water temperatures and long periods with unlimited sunlight. During a 12 month period, rubber crumbs were placed out in the ocean in stainless steel containers and sub-sampled continuously for the measurement of persistent organic pollutants, metals and additives. Hydrophobic persistent organic pollutants such as PAHs, PCBs, DDTs, bisphenols, as well as metals were measured to establish the adsorption and leaching kinetics in seawater under in situ conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by GC and SPE clean up. Chemical analyses using pyroGC/MS, GC/MS/MS and LC/HRMS were done in the laboratories of NILU, Tromsø and SINTEF, Trondheim. Exposure to crumb rubber is currently used to optimize pest control, biofouling, and high mortality rates were found for different marine zooplankton species.

MOPC12
Nanoanalysis of plastic and NNP-FTIR
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To demonstrate the detection of nanoparticles in environmental matrices and their ecotoxicological effects are matters of intensifying research. A significant amount of these particles is generated by degradation and fragmentation processes of larger marine litter. Although experimental proof is scarce, it can be assumed that fragmentation does not stop at the macro scale. This hypothesis is supported by results of our group that were obtained from various environments (e.g. North Sea sediments and arctic ice). A mathematical extrapolation of size dependent particle abundances in the samples returns abundances of up to 3.6 x 10^15 particles cm^-2 for particles with diameters of 0.5 µm. This circumstance raises concerns as particlesaspectricosity. With imaging FTIR this is possible only down to particle sizes of ~10 µm. Electron microscopy suffers from small aliquot sizes and does not provide the opportunity to simultaneously size and identify plastic samples. Nano-FTIR is a novel technique combining the nanoscale local resolution of AFM imaging with near-field infrared measurements resulting in unprecedented material differentiation on a nanometre level. In our proof-of-principle study, we show measurements with defined nanoscale polymers. To demonstrate the detection of nanoparticles in environmental matrices we analysed samples obtained from arctic sea ice. The Nano-FTIR technique is independent from the source of the sample so that it presents a universal tool for application in the analysis of nanoparticles samples from marine but also all other environments.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (PC)

MOPC17
Neonicotinoid insecticides in surface waters discharging into the Great Lakes of Southern Ontario, Canada
T. Sultana, Trent University / Environmental and Resource Studies; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; C.D. Metcalfe, Trent University / Water Quality Centre Neonicotinoid insecticides (NNIs) are a large part of the global pesticide market, as they are very effective at controlling a wide range of insect pests. In Canada, NNIs are used extensively in agricultural regions of southern Ontario to control insect pests on field and greenhouse crops, orchards, nurseries and woodlots etc. Because of their persistence and high solubility in water, there is potential for NNIs to be transported from agricultural fields into surface waters. The objective of this project was to evaluate the distribution of NNIs in surface waters located in areas of intensive agriculture in southern Ontario, Canada that discharge into the Great Lakes basin; specifically into Lake Erie, Lake Saint Clair, Lake Ontario and Lake Huron. Passive sampling with Polar Organic Chemical Integrative Samplers (POCIS) was the principal monitoring technique. To correct for the effect of environmental factors on the rates of uptake of the target NNIs into POCIS, Performance Reference Compounds (PRCs) were spiked into some of the POCIS deployed at each of the monitoring sites. POCIS were deployed for 2 weeks over two different deployment periods and grab samples of surface water were also collected three times over the deployment period. The sites monitored were located in 5 major rivers and 11 smaller creeks in the Great Lakes basin. Static, renewal
MOPC20 Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Gilt Head Bream

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The widespread use of pharmaceuticals has caused a growing concern on the presence of pharmaceuticals such as the antibiotic ciprofloxacin (CIPRO) in the aquatic environment, since they may exert adverse effects on non-target organisms, including fish. In order to study the uptake, distribution in different tissues (liver, muscle, brain and gill) and biofilms (plasma and bile), metabolism and elimination of CIPRO in gilt-head bream (Sparus aurata), controlled dosing experiments for 8 days at 200 μg/L concentration were carried out. CIPRO was only observed in bile, probably due to its low octanol-water partition coefficient and the zwiterionic behaviour. CIPRO by-products (BPs) were also identified in seawater environment, both in presence and absence of fish. The analysis done by means of liquid chromatography-high resolution mass spectrometry permitted the annotation of up to 35 BPs of CIPRO in seawater and bile, from which 30 structures were reported for first time. Up to 20 BPs were annotated in the absence of fish. The phase I degradations suffered by CIPRO in seawater were oxidation, methylation, oxidative defluorination (in 3 BPs out of 20), reductive defluorination (1 BP out of 20), dehydrogenation of the piperazinyl ring (in 2 BPs) and the cleavage of the oxazol-2-one ring with (1 BP) or without (2 BPs) the loss of the primary amineformed during the cleavage. The only phase II transformation of CIPRO observed was BP18 that, apart from the oxidative deamination of the piperazinyl ring, also suffered the glycinem conjugation. 14 of the previously observed BPs were plus 10 new BPs were annotated in water in the presence of fish. Compared to the BPs annotated in the absence of fish, oxidative deamination and both glycinem conjugation gained importance since 4 of the 10 new BPs had suffered both transformation reactions. Although CIPRO metabolites were searched in gill-head bream liver, brain, muscle, gill, plasma and bile, BPs were only detected in bile. 5 BPs were found and none of them was detected in seawater. While defluorination and oxidative deamination gained importance in bile, neither glycinem conjugation of the oxazolinone conjugates was observed in bile BPs. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. H. Ziaurreta is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.

MOPC19 The effect of activated sludge conditions on micropollutants biodegradation and transformation products formation

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Micropollutants such as pharmaceuticals (PhACs) and endocrine disrupting compounds (EDCs) have been detected in all water compartments and the European Union is therefore updating its legislation to limit the release of emerging contaminants. Numerous methods have been developed for the removal of these chemicals and their characterization (bio)degradation and especially on transformation products (TPs) is missing. This work aims at achieving a better understanding of the mechanisms and the operative conditions regulating PhACs and EDCs removal as well as TPs formation and degradation in conventional activated sludge (CAS) systems to maximize their biodegradation. Short term (6 hours) experiments were performed to assess the biodegradation of a set of micropollutants and the formation of some of their known TPs in CAS at different pH (7 and 8) and in aerobic and anoxic conditions at a TSS of 1 g/L. Activated sludge was spiked with a mixture of PhACs (100 μg/L) and EDCs (10 μg/L). The best removal of estrone (E1) was obtained under aerobic conditions at pH 8 (80%), while a 60% removal was observed at pH 7. During the first 30 minutes, E1 concentrations decreased from 1800 to 180 μg/L. The concentration profile drops, suggesting that E2 is oxidized to E1, in consistency with literature. Almost no biodegradation occurred in anoxic batch tests. Estriol was significantly degraded under all conditions. Glucuronides were also monitored, though never detected. EE2 and bisphenol-A were not significantly eliminated in any of the batch tests, though some removal was achieved under aerobic conditions (20 and 15% respectively). In anoxic conditions, enoxiparin was not detected under anoxic conditions, but proved highly biodegradable under aerobic conditions at both pH 7 and 8, leading to the formation of 2-hydroxy-ibuprofen (2-OH-IBU) and carboxyl-ibuprofen (CBX-IBU). 2-OH-IBU concentration increased up to 60% of initial IBU concentration and CBX-IBU concentration raised up to 21% in aerobic batches at pH 7. Metabol新产品 varied from zero (anoxic conditions, pH 7) to 22% of initially spiked concentration (anoxic conditions, pH 8), but its TPs were detected only at negligible concentrations. Sulfamethoxazole (SMX) was not significantly biodegraded by CAS; under aerobic conditions and at pH 7, small amounts of desamino-SFX and acetyl-SFX were produced while 4-nitro SFX was detected at minor concentrations. Venlafaxine and carbamazepine proved to be persistent pharmaceuticals, in consistency with literature.
relevant concentrations in the investigated area and time (above 100 ng/L). As expected concentrations were higher in drainage canals than in irrigation ditches. Measured concentrations were used to evaluate the ecotoxicological risk for the aquatic organisms in this area by means of a hazard quotient-based approach. This work was possible thanks to the Government of Catalonia (2014 SGR 418) and the Spanish State Research Agency (AEI) and the European Regional Development Fund (ERDF) through the project BECAS (grant numbers CGL2014-57587-C2-2-R) and to Merck for the gift of LC columns.

MOPC22
Degradation kinetics and degradation products of dioclefonac with persulfate J.M. Montecagudo, University of Castilla-La Mancha; H. El-talawy, Aarhus University / Department of Environmental Science; A. Durán, J. San Martin, University of Castilla-La Mancha; K. Bester, Aarhus University / Environmental Science
Dioclefonac concentrations in effluent wastewater are often exceeding local limits or upcoming EU regulations. This study was undertaken to explore the possibilities of removing dioclefonac with persulfate in respect to kinetics and reaction pathways. In-situ chemical oxidation of a dioclefonac aqueous solution was performed using persulfate anions activated by ultrasound. The dioclefonac (DCF) removal reaction by the persulfate process and the role of various intermediate oxidative species of persulfate such as hydroxyl, sulfate, superoxide anion or singlet radicals in the removal process as well as to determine a possible reaction pathway was observed. The removal efficiency was highest at pH values below 4.5. In addition, the production rate of sulfate radicals from persulfate as a reagent decomposed via the non reactive $\text{SO}_4^{2-}$ (with no generation of the very effective $\text{SO}_3^{-}$). Sulfate and hydroxyl radicals were involved in the main reaction pathway of dioclefonac. Dioclefonac amide and three hydroxy-dioclefonac isomers (3-hydroxy-dioclefonac, 4-hydroxy-dioclefonac, 4-hydroxy-dioctyl) were identified as reaction intermediates. The obtained results demonstrated that the US/PS process could be a potential alternative to remove compounds of emerging concern, such as dioclefonac from wastewater.

Mercury Biogeoosciences - Fate, Effects and Policy (PC)

MOPC23
Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks
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The Minamata Convention on mercury (Hg) stipulates that complete emissions inventories should be established. Passive air samplers (PAS) produce time-averaged concentration data over long deployment periods and are therefore particularly well suited for mapping gaseous Hg concentrations, identifying and locating unknown Hg sources, and quantifying emission rates. We used networks of PAS in both the Greater Toronto Area (GTA) in Canada and the Monte Amiata mercury mining district in Italy to illustrate this approach to Hg source characterisation. We used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radial diffusive barrier to control uptake kinetics. 145 PASs were deployed across the GTA in July and August 2016 for time periods ranging from 34 to 46 days. In Italy, PASs were deployed at two spatial scales: a 0.56 km$^2$ square comprising the former Abbadia San Salvatore mercury mine and a 41.6 km$^2$ square covering the eastern slope of Mt. Amiata. Both squares were divided into a grid of 7x7 cells and a sampling site was selected within each of the 49 cells. The finer spatial resolution grid was sampled twice with one-week long deployments in Oct. 2015 and Jul. 2016. The coarser spatial resolution grid was sampled for an entire year (Oct. 2015-Oct. 2016), in four seasonal deployments of approx. 3 months each. Mercury gaseous Hg concentrations in downtown Toronto (1.77 ± 0.28 ng m$^{-3}$) were slightly, but significantly elevated relative to other parts of the GTA (1.42 ± 0.20 ng m$^{-3}$). Concentrations at sites close to waste/recycling (1.61 ± 0.22 ng m$^{-3}$) and hospitals/dental facilities (1.63 ± 0.21 ng m$^{-3}$) were significantly higher than at sites presumably distant from potential sources (1.37 ± 0.20 ng m$^{-3}$). In the mine area in Italy concentrations reached as high as 12,500 ng m$^{-3}$ and declined rapidly with distance from the most contaminated site. Concentrations were higher in July than in October. At both spatial scales, concentrations declined less steeply towards the East, consistent with prevailing westerly winds. Atmospheric emission from the mine was estimated to range from 50 to 100 kg annually. Clearly, the PAS’s ability to precisely and accurately discriminate small differences in gaseous Hg concentration (~ 0.2 ng m$^{-3}$) across a wide range of concentrations, including at and near global background levels, enables the mapping of the spatial concentration variability and the identification, characterisation and quantification of both fugitive and major Hg emission sources.

Mercury trend as a possible result of changes in cod age distribution

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Mercury (Hg) enters the biosphere from natural and anthropogenic sources. Methylmercury is the most toxic form of Hg and has a high bioaccumulative potential, thus high concentrations of Hg may accumulate in fish tissue. Mercury in Atlantic cod (Gadus morhua) is one of many things that are monitored through the Norwegian contribution to the Coordinated Environmental Monitoring Programme (CEMP) carried out by the Norwegian Institute for Water Research (NIVA) by contract from the Norwegian Environment Agency. CEMP is administered by the Oslo and Pan Cities (OSPAR), and the results from Norway and other OSPAR countries provide a basis for a paramount evaluation of the state of the marine environment. Some recent inventories showing Hg results between 40 – 50 t Hg/yr in 2004 to 2006. However, only a few attempts have been made to estimate the mercury emission from biomass burning to the atmosphere in South Africa. This study used passive air samplers conducted in the Inner Oslofjord the emission of Cd recruitment in the area has been low since the start of the 2000s. To elucidate how length would possibly impact the trend analysis, the Hg-concentrations in the cod muscle were normalized to that of 50 cm cod. No significant long- or short-term trends could be observed for the normalized Hg-concentrations. The results indicated that most of the upward trend in Hg-concentrations in cod muscle from provides a quantified assessment of the distribution from 2000 to 2017, sampling of larger fish. This again may result from changes in the population structure (e.g. repeated recruitment failure), or changes in sampling bias. These findings point to the need for uncovering the effect of cod length/age on the mercury concentration trends also on other localities along the Norwegian coast. The results from this analysis is newly finalized and will be presented.

MOPC25
Contributions from biomass burning to mercury emissions at Cape Point, South Africa
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Mercury (Hg) is known to be a persistent and toxic heavy metal that can bio-accumulate in the aquatic environment and lead to serious human health effects. Hg is released into the atmosphere from both natural and anthropogenic sources, wherein the atmosphere it can be present in a gaseous phase or in particulate matter. Results of work conducted in Cape Point have shown that the emission of Cd from various sources in southern Africa for the last decade. These studies have shown that the emissions from coal burning are reasonably well documented, with some recent inventories showing Hg results between 40 – 50 t Hg/yr in 2004 to 2006. However, only a few attempts have been made to estimate the mercury emission from biomass burning to the atmosphere in South Africa. This study used passive air samplers conducted in the Inner Oslofjord the emission of Cd recruitment in the area has been low since the start of the 2000s. To elucidate how length would possibly impact the trend analysis, the Hg-concentrations in the cod muscle were normalized to that of 50 cm cod. No significant long- or short-term trends could be observed for the normalized Hg-concentrations. The results indicated that most of the upward trend in Hg-concentrations in cod muscle from provides a quantified assessment of the distribution from 2000 to 2017, sampling of larger fish. This again may result from changes in the population structure (e.g. repeated recruitment failure), or changes in sampling bias. These findings point to the need for uncovering the effect of cod length/age on the mercury concentration trends also on other localities along the Norwegian coast. The results from this analysis is newly finalized and will be presented.

MOPC26
Building a predictive model for methylmercury photodemethylation in freshwater ecosystems
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Quantifying why and how some ecosystems are more sensitive to contamination following atmospheric mercury deposition is key to mercury fate modelling. Photodemethylation of MeHg is thought to be one of the main processes that convert MeHg into a less biologically toxic form of mercury [4]. While previous studies highlight the importance of photodemethylation to mercury budgets, few have examined the magnitude of potential in-stream production of elemental mercury as a function of associated dissolved organic matter (DOM). DOM absorbs specific wavelengths of solar radiation and therefore MeHg that is bound to these compounds containing photoreactive functional groups may be more readily degraded than unbound MeHg. Alternatively, DOM may shade much of the water column and inhibit photodemethylation. To address this research gap we have used nutrient controlled and semi-controlled experiments that focused primarily on the quantification of the relationships between solar radiation exposures, DOM, and MeHg within six freshwater lake systems in Kejimkujik National Park and National Historic Site in southwestern Nova Scotia. Using incident irradiation values measured from floating instrumentation the incoming UV-A could be modelled with depth in the lakes as DOM concentration changes. From these numbers we were able to apply our photodemethylation rate constants, derived from controlled experiments, to available UV-A to predict the loss of MeHg based entirely on DOM concentration (Figure 1). In the subset of Kejimkujik National Park lakes that were studied, lakes with higher DOM lost much less MeHg through the
photodismethylation pathway and a strong seasonal difference due to variation in incoming solar radiation was evident. This model may be appropriate for other aquatic ecosystems by simple standardization techniques depending on water quality characteristics such as DOM phoretactivity (structure), pH, and dissolved ionic species. Overall, this body of work yielded a method for predicting mercury availability to food webs depending on environmental and physicochemical factors. Climate change in temperate and boreal regions of Atlantic Canada is projected to increase coastal and inland exposure and occurrence and thus lead to brownning of freshwaters and further inhibition to the photodismethylation pathway of MeHg reduction.

MOPC27
Polymer inclusion membranes followed by X-ray fluorescence analysis as a new protocol for mercury monitoring in natural waters at low concentration level
G. Elias, University of Girona; E. Murgui, University of Girona / Department of Chemistry; S. Díez, IDAEA CSIC Barcelona; C. Fontas, University of Girona / Department of Chemistry
At present, there is a considerable interest in mercury (Hg) monitoring due to its widespread occurrence and high toxicity of most of its compounds. Due to the low concentration levels, the complexity of some natural waters and the poor stability of the metal during sample storage, methodologies overtaking these problems are of main interest. In this context, polymer inclusion membranes (PIMs) can be an interesting tool to help in environmental monitoring. PIMs consist of a polymer, which provides mechanical strength, the carrier, which is the responsible of the extraction process, and sometimes also a plasticizer can be used to provide elasticity. The stability, versatility and easy manufacturing make PIMs as a useful separation technique to be taken into account. In this work, PIMs have been prepared fixing cellulose triacetate as polymer and the ionic liquid trioctylmethylammonium thiocyanate (TOMATS) as extractant. PIMs were contacted with Hg in natural waters and, once the metal was collected, membranes were used as the source of mercury for the determination of the metal by direct mercury analyzer (DEXRF) system and were directly analyzed. A good correlation was found between Hg concentration in the natural water (0.5-10 ppb) and the peak area obtained in the analysis of the corresponding loaded PIM, and thus, it can be used as a calibration curve. Optimized conditions of the whole methodology allowed a Hg detection limit of 0.2 µg g⁻¹ Hg L⁻¹ in water. Moreover, no water matrix effects were observed when testing tap water, river water, sea water and ground water were found. Thus, PIMs can be seen as a global solution for Hg monitoring in all types of natural waters. Additionally, we have investigated for the first time, the possibility of using PIMs as a tool to preserve samples of Hg in environmental waters. PIMs analyzed after 6 months of Hg extraction did not differ from the results obtained the first day of analysis. Hence, PIMs can be viewed as an innovative media to extract low levels of metal from different natural waters and preserve sample information until the determination of the metal can be performed.

MOPC28
Dissolved organic matter as a modifier of Hg bioavailability to phytoplankton
V. Díez, University of Seville / Department of Chemistry; S. Díez, IDAEA CSIC Barcelona; C. Fontas, University of Girona / Department of Chemistry
Dissolved organic matter (DOM) as the reductant of mercury (Hg) from its most toxic species to its least reactive form plays a crucial role in aquatic ecosystems. In the aquatic environment, DOM is to elucidate. The objective of this work is to get new insight in the role of the DOM on Hg bioavailability to phytoplankton. Since trace metal complexation by DOM is expected to reduce its bioavailability, we hypothesized that the reduction of the Hg bioavailability to Chlamydomonas reinhardtii, chosen as a model phytoplankton, will be proportional to the fraction of the Hg being complexed by DOM. To get insight into the role of DOM in Hg uptake, C. reinhardtii was exposed to two concentrations of Hg in the presence of standard Suwannee River humic acid (SRHA) and in natural water rich in DOM from Onega Lake, Russia. Water was sampled from five sites representing the DOC gradient from River Shuya to open lake. Bioavailability was quantified by determining the adsorbed and intracellular mercury concentrations by Direct mercury analyzer on freeze-dried pellets. Concentrations of Hg in the exposure media were measured with the MERX Automated Total Mercury Analytical System. Chemical speciation of Hg in the absence or presence of DOM was computed with WHAM/Model VII. The results showed that adsorbed and intracellular Hg concentrations decreased as compared with exposure in the absence of SRHA only at 0.7nm Hg, when the ratio between the reduced sulfur concentration and Hg is bigger than 100. A significant increase (1.5x) of Hg uptake in C. reinhardtii exposed to 70 nM Hg in the presence of 0.5 and 5 mg L⁻¹ DOC was found. In the DOC-rich water from lake Onega, a decrease of the bioavailability with respect to exposure in the absence of DOM was found. However no specific trends in the Hg uptake by C. reinhardtii were observed over DOC concentration gradients. The effect of the other factors such as the presence and concentration of different major cations and anions, as well as mercury binding to the Al, Mn and Fe colloids has to be taken into account in addition to the role of DOM. The implications of the obtained results are discussed further with respect to the prediction of the mercury incorporation at the base of the food-webs and the impact in the environmental systems.

Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (PC)
TUPC01
Overview on the risks from fungicides for aquatic organisms
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As fungal pests are a major threat to crop production, the application of fungicides to control fungal infestations is considered indispensable to secure global food supply. The use of fungicides is forecasted to increase due to altered climatic conditions and invasive fungal species. Following their use, fungicides can enter aquatic ecosystems and, given their typically frequent application, ecotoxicologically relevant levels of fungicides can occur in surface water bodies in agricultural catchments throughout the growing season. However, in comparison to herbicides and insecticides, the fate and effects of fungicides have received less attention. To highlight research gaps, we reviewed the current knowledge on fungicide effects for aquatic organism groups (microorganisms, plants, as well as invertebrate and vertebrate animals) with a particular emphasis on the functional and ecosystem level. Related contributions reviewed fungicide exposure and mitigation measures. Within aquatic systems, aquatic fungi appear to be particularly at risk of adverse effects because fungicides are designed to control their terrestrial relatives during crop production. Indeed, structural and functional implications in aquatic fungal communities have been reported in field and laboratory studies. As fungi positively (e.g., conditioning of detritus) and negatively (e.g., via parasitism) interact with other organisms, such effects have been shown to result in indirect fungicide effects on other taxonomic groups. In addition, other taxonomic groups can also be directly affected by fungicides because these substances act on biological processes that are highly conserved (e.g., energy production). Direct effects of fungicides have been reported on a variety of non-fungal microorganisms, plants, as well as invertebrate and vertebrate animals. We will discuss these effects for several fungicide/mode of action groups that were comprehensively tested in laboratory and semi-field studies. Subsequently, we discuss current risk assessment procedures for fungicides in the light of identified knowledge gaps and provide recommendations for amendments that can be inferred from our findings.

TUPC02
Relative tolerance of aquatic organisms to fungicides
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Fungicide compounds are routinely used in intensive agriculture production to treat a wide range of plant pests and microbial pathogens. These compounds may reach aquatic ecosystems by spray-drift, leaching and runoff, posing a potential threat to aquatic organisms. In this study we evaluated the sensitivity and relative tolerance of different aquatic organisms exposed to fungicides. A toxicity database was created that contained acute and chronic laboratory toxicity data for 182 taxa and 139 fungicidal compounds. Toxicity data was obtained from the US EPA ECOTOX database and complemented with data contained in EFSA draft assessment reports. The data was selected following strict criteria as regards to the endpoints, measured effect and exposure duration proposed by the EFSA Aquatic Guidance Document for the aquatic effect assessment of plant protection products. Sensitivity differences between non-standard and standard test species were assessed following the relative tolerance (Trel) approach i.e., by dividing the toxicity value of a non-standard test species by the toxicity value of the standard test species. Trel values were calculated on the basis of the standard test species used in the acute first week test (Daphnia magna, Oecetochybus mykiss) and chronic first tier (Raphidocelis subcapitata, D. magna, O. mykiss) effect assessments. Trel values were averaged per taxonomic group and per antimicrobial toxic mode of action of the evaluated compounds. The results of this study reveal that, on average, annelids, mysids and bivalves have a higher acute sensitivity to fungicides than D. magna, although such trend was not observed in the chronic sensitivity evaluation. O. mykiss was confirmed to be among the most sensitive fish species to fungicides. Regarding the primary producer evaluation, diatoms were found to be more sensitive than R. subcapitata in the majority of the cases. Sensitivity differences were generally less than two orders of magnitude in the acute assessment and less than one order of magnitude in the chronic assessment, indicating that the assessment factors applied to toxicity values for standard test species encompass the sensitivity range of non-standard test species. The data patterned most closely to the antimicrobial toxic mode of action of the evaluated substances was not identified.
Fungicide effects propagate through the detrital food chain in streams

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Fungicide use in Europe equals that of herbicides, but the amount of studies addressing ecological effects of fungicides is disproportionately low. Recent studies suggest that particularly freshwater fungi may be susceptible to fungicide exposure leading to changed fungal community structure and reduced fungal biomass. These effects may negatively influence the food quality for higher level consumers, e.g. invertebrate shredders. Fungi occur rather continuously in low concentrations in agricultural streams especially during cropping seasons suggesting that long-term chronic exposure scenarios should be covered in ecotoxicological research. We conducted a 5 month stream channel experiment using two environmentally realistic concentration levels of a quaternary fungicide mixture to investigate long-term effects of chronic fungicide exposure of a leaf decomposer assemblage containing fungal communities and two species of caddisfly shredders: Chaeopterus villosa and Anabolia nervosa. Food availability was additionally manipulated ranging from excessive to limited food availability (three treatment levels). Fungal biomass significantly decreased with increasing fungicide concentrations, and the fungal community structure was significantly different in the highest fungicide treatment compared to the lowest fungicide treatment and the untreated control. Fungal species richness was consistently and significantly lower in the treatments. Fungicide fungicidal concentration a factor of 20 to 200 below the EC_{50\text{amo1}} concentrations for chronic algae ecotoxicity tests. Our study highlights that environmentally realistic fungicide exposure may propagate through the detrital food chain in streams at concentrations that are well below the Regulatory Acceptable Concentrations. Hence, supplemental ecotoxicity tests (e.g. based on aquatic fungi) are probably necessary for sufficiently safeguarding stream ecosystems in the risk assessment of fungicides.

Mitigation of fungicide exposure of stream ecosystems within agricultural catchments

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Fungicides are a vital part of the agricultural pest management. As a consequence, fungicides – such as all pesticides – reach surface water bodies mainly through spray drift, runoff, and leaching. To mitigate fungicide exposure a range of mitigation measures have been put forward. A densely vegetated and wide buffer strip surrounding surface water bodies, for instance, can be efficient to reduce the spray drift of fungicides during application. Also during runoff, buffer strips have been suggested as a potential measure mitigating fungicide exposure by retaining runoff water and providing sites for adsorption as well as degradation. Under field conditions, however, the vegetation density and erosion rills underneath the buffer strips’ mitigation potential. Once released into aquatic ecosystems, (constructed) wetland and vegetated systems are considered an effective tool for mitigating a downstream transport of pesticides. The efficiency of such systems depends on both the physico-chemical properties of the pesticide of interest as well as system inherent properties. The pesticides affinity to organic carbon (Koc) is one physico-chemical property driving their retention, with more hydrophobic substances being more efficiently retained. Although fungicides are usually rather hydrophilic, their peak concentrations were also shown to be reduced by such vegetated systems. The systems’ efficiency in doing so, is modulated by size related properties as well as plant density. Both parameters are increasing the retention of fungicides and thereby the probability for adsorption and degradation processes to take place. Mitigating the fungicide exposure via spray drift and runoff may thus efficiently be addressed by a combination of measures. Those measures may include the proper management of vegetated buffer strips. This mitigation measure may be supported by the implementation of vegetated systems (such as constructed wetlands) in situations where catchment characteristics suggest a high risk that cannot be controlled by buffer strips or where such buffer strips cannot be realised.

Towards a better exposure assessment of antifungal azoles

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Antifungal azoles are a class of contaminants of emerging concern since increasing evidences highlight their potential effect on aquatic organisms at different trophic levels, raising the need to evaluate the associated environmental risk. Although a few of these compounds are routinely investigated, an accurate exposure assessment of most of them is still lacking to evaluate this risk. To address this issue, we first defined a list of 60 antifungal azoles including pesticides and pharmaceuticals based on the use/consumption of these compounds in Switzerland and Germany. We then performed a retrospective suspect screening on a set of data acquired with liquid chromatography-high-resolution mass spectrometry (LC-HRMS) from a large panel of environmental samples to complete previously targeted analyses on azoles. Since antifungal azoles are used both as pharmaceuticals and pesticides these samples included wastewater treatment plant effluents (WWTPs), river surface waters, biota from rivers (fish, gammarids, biofilms), river and lake sediments, soils and groundwater from various sites allowing to encompass different sources of anthropogenic pressures. The results revealed that antifungal azoles are widely distributed in aquatic ecosystems (e.g. from

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TUPC06

Is the EFSA effect assessment approach for fungicides sufficiently protective for aquatic ecosystems?

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In Europe, the EFSA Aquatic Guidance Document describes the procedures for the derivation of regulatory acceptable concentrations (RACs) for pesticides on the basis of tier-1 (standard test species), tier-2 (genotoxic and SSD) and tier-3 (micro/mesocosms) approaches. The consistency of this tiered approach has previously been evaluated for insecticides. In the present study, results of different tiers are compared for fungicides. To this end, laboratory toxicity data and microcosm/mesocosm data were compiled from open data sources supplemented with data from confidential studies conducted for the Industry. RACs for tiers 1, 2 and 3 were calculated following the guidelines described in the EFSA Guidance Document. This presentation will discuss i) the consistency of the tiered effect assessment approach for fungicides as proposed in the EFSA Aquatic Guidance Document; ii) the predictive value of acute and chronic laboratory toxicity estimates for observed responses in microcosm/mesocosm tests; iii) problems in using the Geometric Mean approach in the acute effect assessment for fungicides with a biocidal mode-of-action; and iv) the taxonomic groups that should be represented in species sensitivity distributions for fungicides with a biocidal mode-of-action.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semicochemicals and botanicals (PC)

TUPC07

Ecotoxicology studies performed to assess the potential of a yeastlike fungus, Aureobasidium pullulans, and the response of evaluating authorities C. Donat, bio-ferm GmbH

In the course of inclusion of two strains of the species Aureobasidium pullulans as active substances to be used in plant protection products in Annex 1 of the Directive (EU) 91/144, a data package was developed to assess the ecotoxicity of these yeastlike fungi. Back then no methods designed for the evaluation of microorganisms as active substances did exist. Methods were based upon certain parts of OECD methods (Section 2) and some advise was found in the EPA OPPTS Series 855 Microbial Pesticide Test Guidelines published by US EPA. However, in some test systems it seemed appropriate to work with scientists of the university to find adequate solutions. Hence some additional “unconventional” results like the Flying doctors experiments with bees as well as an avoidance test with earthworms were available. Whereas EFSA identified data gaps, the European Commission decided to include Aureobasidium pullulans to Annex I without requiring any additional study. National decisions for the registration of the product varied, some authorities authorized the use with any limitations, whereas other demanded up to 30m distance from surface water. However, it is important to think out of the box by evaluating these products used in agriculture. It is evident that living microorganisms are able to proliferate, depending on the local environmental conditions in their micro-niche (influenced by climatic factors as well as microbial population dynamics), it is hardly possible to simulate all these complex conditions in laboratory trials. Therefore, a quantitative assessment does not seem to be a
Biological properties of the microorganism have to be taken into account, instead of chemical pesticides and often cannot be adapted to the biological properties of microorganisms. In order to address the data requirements in a feasible manner, the requirements listed in these annexes were transformed directly for mBCAs and mBCPs are issue of Part B of the European Commission Regulation 1107/2009. Biopesticides cover a wide spectrum of substances including microbial pest control agents (MPCA) defined as products containing microorganisms (e.g. bacteria, fungi, protozoa, viruses). As chemical plant protection products, regulatory authorities require an analytical verification of the doses applied in ecotoxicological tests also for MPCAs. Guidance can be derived from SANCO/3030/99 rev.4 and OPPTS 885.1400 (1996), but verification procedures need to be adapted on a case by case basis, as each microorganism possesses its own chemical properties and different growth conditions. Just as chemical methods, microbial methods need to be robust and specific. Experimental data will be presented with focus on the applicability of microbial quantification methods considering different microorganisms and substrates.

When ecotoxicology meets trophic ecology (PC)

Modelling bioaccumulation of persistent organic pollutants in Arctic food chains

Other Legacy POPs in the Maritime Antarctic Ecosystem

Distribution and Trophic Magnification of Dechloranes, HBCDs, PCNs, and Other Legacy POPs in the Maritime Antarctic Ecosystem

Modelling bioaccumulation of persistent organic pollutants in Arctic food chains

Biopesticides are an excellent alternative to chemical pesticides, and there is continuously increasing interest with both industry and consumers. The Sustainable Use Directive (SU, 2009/128/EC) strongly promotes a targeted use of integrated control of pests and diseases where non-chemical measures are preferred. Plant protection products with a microorganism as active substance could be a solution. Microorganisms have to be approved in Europe in order to be used as active ingredients in biopesticide products. Data requirements for pesticides based on microorganisms are available as separate part of regulation EC 283/2013 and EC 284/2013. The Regulation provides the scope of the data requirements and regulates the approval. Series of guidelines published by OECD, SANTE, or EPPO are available for testing of substances used in plant protection. Many of these guidelines are not adapted for microorganisms. Risk assessment for biopesticides to enter the European market is described in the Uniform Principles, Commission regulation EU 546/2011 Part II. Risk assessment approaches for plant protection products with a microorganism as active substance are not yet developed for microorganisms. Thus, no consistent approach is available in the different member states. This leads to uncertainties and non-acceptance of submitted data. We will discuss the current challenges in interpretation of the data requirements and propose solutions for the risk assessment of biopesticides based on microorganisms.

Ecotoxicological testing to support the assessment of Microbials

Human and environmental Risk assessment for microorganisms - to what extent?

Hexachlorobenzene (HCBz), Chlorodanes, PCBs were detected in all samples, and persistence of some new POP compounds were only 50%. The detected POP levels in this study were strongly influenced by physico-chemical properties of mBCAs. Microorganisms, i. a. with frequently used co-formulants, are not soluble which results in alteration of the test conditions (i.e. turbidity, O₂-demand, spray layers). Additionally, the need to test at high concentration levels, lead to specific effects of particles (i.e. spores or co-formulants like kaolin) on the test organisms which are not related to the active substance and are difficult to interpret. Differences between OECD and OCSP (formerly OPPTS) guidelines, and requirements of the analytical verification in the test medium are addressed as part of the development of alternative ecotoxicological testing approaches. The findings of our ecotoxicological expertise presented in this poster can be considered as basis for further discussion in proposing different test designs addressing mBCAs and mBCP requirements.

Microbiological Quantiﬁcation Methods for MPCAs - Applicability to a Range of Microorganisms and Different Substances

Microorganisms have to be approved in Europe in order to be used as active substances. Possible adverse effects to non-target organisms may allow development of some generic testing recommendations. Considerations of microbial active substances in groups based on pesticide mechanism of action and/or organism group may allow development of some generic testing recommendations. Knowledge from both the biological and chemical testing and risk assessment areas should be comprehensively surveyed and utilities to advise more appropriate and adequate testing for microbial active substances.
study were much lower than the levels in the previous study in low and mid latitude region, and even those in the Arctic. The trophic magnification factor (TMF) of each POP compound were calculated based on the ratio of stable isotope nitrogen and the log-transformed POP concentrations. Some of the compounds, OCPs, HBCDs and highly chlorinated PCBs and PCNs, showed significantly positive correlations, suggesting biomagnification of the chemicals. DPs, however, showed insignificant results. After the trophic TMF analysis for aquatic and terrestrial food web models, TMF values showed different trends compared to the TMFs in whole sample model. The inclusion of multiple migrant, such as south pola skua and kelp gull, also arose an uncertainty to evaluate TMFs. The result of this study presented widespread contamination of the Arctic Environment by the New and Legacy POPs. The levels of most POPs were magnified through trophic levels, while Dechloranes, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechloranes, complexity of the food web structure, and the overestimation due to migrant animals arose the uncertainties in TMFs, and therefore need to be taken into consideration to interpret the TMF results in this study.

TUPC19 Bioconcentration as the predominant mechanism for fish PCB contamination in alpine lakes.
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Bioconcentration and biomagnification relative contribution to the PCB burden in freshwater fish in alpine lakes ecosystems remain a debated issue. The aim of this study was to identify the relative role of those different processes for two fish species Coregonus lavaretus (European whitefish) and Salvelinus alpinus (arctic char) in one of the heaviest PCB contaminated alpine ecosystem: lake Bourget (France). The 7 indicator-PCB concentration and lipid content of fish filet were measured in European whitefish (n = 89) and arctic char (n = 55) from 2013 to 2016. Potential explanatory variables for differences in PCB contamination levels in fish were chosen to identify the impact of living and feeding habitat (using d13C) and the influence of trophic parameters using d15N and body size. Results showed a decrease of PCB burden in fish after the clean-up of the major input source of PCB in the lake and a steady situation since then. Arctic char was found to be significantly more contaminated than whitefish with a mean concentration of 25±132 ng.g⁻¹ w/w and 45±28 ng.g⁻¹ w/w respectively. Individual’s PCB contaminations in both species were not tied to feeding habitats (p>0.05). Trophic position (characterized with d13C) was also not correlated with intra-species concentration variabilities for the char and was only slightly positively related to concentration variabilities for whitefish (p=0.04), dismissing the importance of biomagnification as PCB accumulation process. However, fish body size seemed to be a potential explanatory variable for individual’s PCB concentration discrepancies in arctic char (p=0.002) and whitefish (p<10⁻⁶). This last observation could be explained by fish/water partitioning equilibrium to be reached, where fish would tend to accumulate more PCB through their lifetime, highlighting the effect of the bioconcentration process. A lower clearance rate due to changes in physiological parameters (lower gill/body weight ratio, lower metabolism and/or excretion rate) could also be involved.

TUPC20 The role of diet and age: organohalogen accumulation in an avian top predator
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Occupying a high trophic level, the white-tailed eagle (Haliaeetus albicilla) can accumulate a wide range of organohalogenated contaminants (OHCs), even at an early age. Their diet consists mainly of fish and seabirds; thus, a long food chain potential resulting in biomagnification of OHCs. The nests can be exposed to high levels of OHCs through maternal transfer from the egg, and later through the diet. As nestlings develop and grow, concentrations of maternally derived compounds increase at a faster rate than those in the diet, explaining variation in POPs but not PFAS levels. We also observed that age at sampling is an important factor, as legacy POPs are decreasing while PFASs are increasing with age. However, there are differences between years at each location with higher OHC concentrations for Steigen in 2015 and Smøla in 2016, not explained by age or diet. Our analyses also demonstrate large variations within and between locations, suggesting that siblings may not always share prey. These data highlight the importance of ecological and biological variables when investigating OHCs in an avian top predator.

TUPC21 Fate of PAH, phthalates and their metabolites in an urban river food web
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Trophic magnification factors have been extensively assessed for persistent organic pollutants, but remain poorly studied for metabolizable pollutants and their metabolites. Polycyclic aromatic hydrocarbons (PAHs) and phthalate plasticizers are continuously released in urban rivers and are rapidly metabolised and excreted by freshwater organisms, thus limiting their bioaccumulative potential. Abiotic and biotic samples, from primary producers to piscivorous fish, were collected in an urban river and analysed for PAHs, phthalates and their metabolites. Stable isotopes of nitrogen were used to determine trophic levels and to calculate trophic magnification factors (TMF) of each compound and its associated metabolite. Our results highlight a trophic dilution (TMF < 1) of all PAHs and phthalates, meaning that predators were less contaminated than their prey. When taking into account the associated metabolites, total body burden of PAHs still declined with increasing trophic levels, confirming the rapid transformation and excretion of these compounds within organisms and a very limited trophic transfer. In contrast, the level of phthalate compound and its associated metabolite(s) increased from prey to predators, suggesting a lower clearance rate of phthalates and a slight biomagnification potential across freshwater food webs. At the light of these results, it appears essential to consider phthalate metabolites, instead of phthalate diesters only, in environmental risk assessment.

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (PC)
WEPC01 Does pre-exposure to bisphenol A affect the susceptibility of breeding zebrafish upon re-exposure?
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Bisphenol A (BPA) is a commonly used chemical used in the production of widely used epoxy resins and polycarbonate plastics and it is ubiquitous in the environment, resulting in widespread exposure of humans and wildlife. BPA was shown to cause reproductive effects via disruption of both the oestrogen and androgen signalling pathways. Recent studies suggest that BPA also affects epigenetic signalling pathways, including alterations in transcription of DNA methylation maintenance enzymes and altered DNA methylation profiles. This study aims to investigate how previous exposure of adult fish to BPA affects their response and the response of their offspring upon re-exposure, and whether there is an epigenetic basis for these effects. Breeding groups of zebrafish (Danio rerio) were exposed to 10 and 100μg BPA/L for 5 days, either once (C-10, C-100) or twice (10-10, 100-100) with a 13 day period of depuration in between, and appropriate controls were maintained in parallel. The adult gonads were sampled for transcriptional analysis. Reproduction was quantified over time, and embryos from each treatment group were then exposed to a range of BPA concentrations from 0-72μg/L to measure their susceptibility to BPA exposure. There were no effects on reproductive output under our exposure conditions. However, at the transcriptional level, anti-Mullerian hormone (amb) was significantly down regulated only in fish receiving the highest concentrations to BPA (100-100). In addition, embryos originating from adults which received a pre-exposure to BPA (100-100) were significantly more tolerant compared to embryos originating from diphenyl ethers (PBDEs) and 8 per- and polyfluoroalkyl substances (PFASs) were quantified in over 50% of the analyzed plasma samples at each location and year. The WTE is a marine top predator; however due to the topography of the island Smøla WTEs may feed on a mixed terrestrial and marine diet. According to our preliminary analyses, WTEs in Steigen are feeding on a slightly higher trophic level than WTEs in Smøla WTEs, and may consequently accumulate more of the investigated OHCs. Therefore, in our analyses the SI values were only important in explaining variation in POPs but not PFAS levels. We also observed that age at sampling is an important factor, as legacy POPs are decreasing while PFASs are increasing with age. However, there are differences between years at each location with higher OHC concentrations for Steigen in 2015 and Smøla in 2016, not explained by age or diet. Our analyses also demonstrate large variations within each location, suggesting that siblings may not always share prey. We hereby emphasize the importance of ecological and biological variables when investigating OHCs in an avian top predator.
naive adults which received a single exposure to BPA (C-100). This suggests that pre-exposure of adult fish leads to a protective effect on their offspring. We hypothesise that these effects may be due to physiological changes or epigenetic memory between the first and second exposure period, and we will now analyse the promoter DNA methylation of amh to investigate this hypothesis.

WEPC02  
Zebrafish as a model to assess transgenerational effects of environmental stress via epigenetic inheritance  
J. Kamstra, NMBU / BaSam

Although toxicological effects of anthropogenic stressors present in the environment are studied extensively, few studies assess the epigenetic effects of such stressors and are aimed at assessing these effects over multiple generations. It is hypothesized that some stressors are able to change the epigenetic state in germ cells causing effects on histones modifications, DNA methylation and miRNA expression, potentially inherited by subsequent generations. Here, the aim was to elucidate the role of epigenetics in transgenerational inheritance of effects of different stressors by measuring all epigenetic layers using the zebrafish model. Transgenerational studies were performed with three different stressors: a DNA methylation inhibitor, 5-azacytidine (5AC); a phthalate metabolite, mono2-ethylhexylphthalate (MEHP) and ionizing radiation. We employed state-of-the-art techniques to assess effects in multiple generations of zebrafish embryos and larvae at all epigenetic layers, but most extensively on DNA methylation. Following early life exposures to 5AC and MEHP, many changes of DNA methylation were found in the first, second and third generation, revealed persistent effects of DNA methylation in a number of regions. Additionally, miRNA analysis in the offspring revealed a number of differentially expressed miRNA linked to similar pathways as with the DNA methylation dataset. Finally, changes in histone modifications were found at specific loci, but these changes were not observed in the second generation. Our results reveal considerable effects on DNA methylation following exposures during early life in zebrafish to MEHP, 5AC and ionizing radiation, as well as a role for miRNAs and histone post translational modifications for the latter. By linking the DNA methylation data to genes, results indicate a functional role for DNA methylation in zebrafish. Persistent effects in F2 and F3 implies that DNA methylation changes can be inherited by multiple generations.

WEPC03  
Can changes in DNA methylation be linked to exposure of plants to radiation over multiple generations?  
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In this study the impact on plants of long-term (transgenerational) exposure to radiation coming from nuclear accidents like Fukushima and Chernobyl is investigated and compared with lab experiments in either a chronic, acute, multi-, or single exposure. The transgenerational set was run for 16 years. Changes in DNA methylation could be the basis of transgenerational changes found in field or lab conditions. A field campaign was performed in both Chernobyl (CEZ) and Fukushima affected areas (FEZ) in the course of May 2016. Annual Brassicaceae plants, Arabidopsis thaliana and Capsella bursa-pastoris in CEZ and FEZ, respectively, were sampled alongside a gradient of enhanced radiation ranging from 0.5 to 50 µGy.h⁻¹. Seeds from Arabidopsis thaliana were harvested in the CEZ and grown for one clean generation under lab conditions to score for multigenerational effects. In addition further lab experiments were performed on wild type plants of Arabidopsis thaliana grown under chronic exposure conditions (at 1 mGy/h) or more acutely (20 to 400 mGy/h) for 14 days in one, two or three generations. Plants were exposed for that duration to 24 h/day photosynthesis carbon and oxidative stress markers as well as germination rate and root growth. In general higher differences are found in plants exposed in a multigenerational setup than in a transgenerational one. The field plants did not show any abnormalities that could be correlated with the exposure gradient although some delay in flowering was observed in plants from medium and high radiation levels. The level of total DNA methylation could not be linked to the gradient present in the field but rather differences in developmental stage of the collected plants. In lab-exposed plants however global DNA methylation showed a significant increase which was both dose and generation dependent. Significant changes in transcription of methylation regulating genes were also measured in the different generations. Highest differences were present in the S1 generation but seemed to be reduced in the S2 generation. Overall the data hint towards a role of methylation in the response to radiation but its use as marker of exposure or in risk assessment needs further experimental evidence and discussion. This work was supported by European project COMET (7th PCRD EURATOM Contract Number: Fission-2012-3.4.1-604794) (www.comet-radioecology.org)/generation.

WEPC04  
Evolutionary toxicology: tools to understand impacts of past, present and future environmental contamination  
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This research will utilize environmental reconstruction methods along with paleoecological, palaeoecological, and palageneic techniques to understand historical, current and potentially future trends in environmental contamination and associated impacts on lake systems. Long-term exposure to environmental contaminants can cause genetic adaptations in exposed populations of aquatic organisms. The new research fields of evolutionary toxicityology and resurrection ecology offer powerful tools for the investigation of changes in sensitivities and adaptive trajectories of populations exposed to contaminants and environmental stressors over decades to centuries. Dormant resting eggs produced by Daphnia species (Crustacea: Cladocera) as a result of unfavourable environmental conditions are archived in sediments and can be dated and hatched to produce clonal lineages (i.e., same genotypes) of historical populations. This talk will present an overview of the evolutionary tools available and their current and potential use in toxicological investigations. Additionally, we will present our preliminary research, which examines how genotypes of clonal lineages of Daphnia species from single populations, separated through generations of evolution, differ in their response to exposure of stressors. Results will provide insight into the sensitivity and fitness of organisms in response to environmental contaminant exposures and the micro-evolutionary adaptations of genes that evolution in response to chronic low exposure. In the future, more frequent and increasing mutation rate in aquatic organisms can also result from other environmental stressors, such as temperature. Since increased temperatures are expected to occur in the future as a result of predicted climate scenarios, it is important to examine the fitness of historical and recent clones of Daphnia to temperature changes in combination with exposure of contaminants. Toxicological assessments and genomic data obtained from these archives of natural populations will provide unprecedented opportunities to gain insight into long-term and potentially future evolutionary responses of natural populations to environmental changes resulting from environmental stressors, including contamination and climate change.

WEPC05  
Chemical and physical stressors shape the population genetic structure of aquatic invertebrate populations  
P. Inostrzoza, University of Gothenburg / Effect Directed Analysis; I. Vera-Escalona, Dalhousie University / Biology; A. Wicht, Eberhard Karls Universität Tübingen / Chemistry; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect Directed Analysis; H. Norf, Helmholtz Centre for Environmental Research GmbH - UFZ / River Ecology Aquatic Ecosystems Analysis and Management

Organisms are rarely exposed to only single stressor in the environment, but rather to multiple human-derived threats working simultaneously. Environmental pollution can modify population genetic structure via ecological bottlenecks, changing genetic compositions of species towards altered genetic structures. Furthermore, evolutionary change in aquatic organisms can also result from other environmental stressors, such as temperature. Since increased temperatures are expected to occur in the future as a result of predicted climate scenarios, it is important to examine the fitness of historical and recent clones of Daphnia to temperature changes in combination with exposure of contaminants. Toxicological assessments and genomic data obtained from these archives of natural populations will provide unprecedented opportunities to gain insight into long-term and potentially future evolutionary responses of natural populations to environmental changes resulting from environmental stressors, including contamination and climate change.
What's your take on communication? Don't Panic! Reports on how to accurately communicating science and risk (PC)

WEPC07
Dangersous misconceptions - Consumers need help!
U. Klawecka, University of Applied Sciences

Previous surveys revealed that average consumers and even more illiterate persons are struggling with risk communication instruments for harmful substances in commodities. The majority of consumers do not understand risk communication instruments as intended by legislators or do not use them at all. In contrast, the present survey focused on ‘best-case’ consumers who are interested in the topic, have a good education or a good self-reported knowledge in chemistry. These ‘best-case’ consumers use preferably hazard pictograms in accordance with the Regulation on Classification, Labelling and Packaging (86%), reports in the media (80%) and information printed on the products (77%) to learn about harmful substances in consumer products. Surprisingly, smartphone applications (10%) and information by authorities (14%) were not indicated as frequently used information sources. Most respondents considered information published by consumer and environmental organizations (75%) and the hazard pictograms (74%) as trustworthy. Interestingly, the respondents considered legislators (94%), consumers (75%), manufacturers (71%) and environmental and consumer organizations (61%) as responsible for risk reduction. It is alarming that many of these ‘best-case’ participants assumed that food (up to 62%), products with an environmental label (36%), natural personal care products (36%), homeopathic products (30%), natural pharmaceuticals (26%) and products without hazard pictograms (11%) would not contain substances harmful for health or the environment. Nearly one out of ten respondents did not know that consumer products can contain harmful substances. These results show that motivation and knowledge in chemistry help, but are not sufficient. Consumers need support to understand these risk communication instruments they need support to understand which products might contain harmful substances, they need support to determine the impact of harmful substances in commodities and they need support for suitable risk reduction behavior.

WEPC08
The European Union Observatory for Nanomaterials (EUON): A new platform for communicating information on the safety of nanomaterials

The REACH and CLP regulations are two key regulations addressing the manufacture and use of chemicals and the impact of these chemicals on human health and the environment. Although these regulations do not contain explicit requirements for nanomaterials, the regulations nevertheless address all chemical substances, including nanomaterials. In addition, over the past years, significant developments and technologies decrease which leaves less time for thorough risk assessments. In this context it is useful for environmental scientists to be familiar with the concept of climate services which are defined as the transformation of climate-related data into products (trends, assessments, best practices) in relation to climate that may be of use for the society at large in terms of risk reduction. Since the climate service sector is relatively new, there is a need to engage knowledge providers, users, and translators to identify improvements to climate services through co-design, co-development and co-evolution. The EVOKED project aims to address this challenge by re-framing the risk and uncertainty associated with climate data into knowledge products more understandable and useful for end-users concerned with risk mitigation and adaptation. The project team will engage end-users in a Living Labs approach to ensure a user-contribution innovation methodology at established case study sites in Norway, Sweden, Germany and the Netherlands. The Living Lab methodology has emerged in recent years as a form of experimental and potentially inclusive mode of urban planning. Although the scope and character can vary depending on the issue at hand, the institutional level and the size of the problem, the general idea is to involve a range of committed stakeholders in a real-life “laboratory” setting to test and develop alternative solutions for complex challenges, such as climate adaptation. The first activity for the Living Labs at each case study site will be a co-design process to encourage stakeholders to share their perceptions of risk and uncertainty. Since there are many different definitions and interpretations of risk, understanding these perceptions of risk is a prerequisite for communicating risk. Thus, EVOKED supports the development of the field of climate services to improve our capacity to manage climate-related risks.
Rydberg, JVL Swedish Environmental Research Institute; A. Wikström, Chalmers University of Technology

Monetary valuation of environmental impacts from human activities is a way of understanding and communicating its societal significance. However, monetary values are easy to accept without knowing the many ways they can be determined and the many perspectives they may represent. ISO TC 207/SC1 has set up a working group to develop a framework standard on monetary valuation of environmental impacts and related aspects (sensitivities and use of resources) to increase transparency and its use in management. The standard contains requirements and recommendation on how to document and report information (metadata) about what a monetary value represents and how it is developed. As a part of the Swedish contribution to the work, three case studies were made to test the framework and to find out which metadata that had the greatest influence on decisions made. The cases represented three choices of ways to produce energy, one between natural gas and waste and heat from waste incineration, one between different vehicle propulsion techniques, and one between different ways of sludge treatment and energy recovery. We have used the EPS 2015dx method to value emissions and resources and a national Swedish database used for cost-benefit studies. The results indicate that the important metadata to report is the system boundaries of the impact valuation i.e. which impacts on which environmental goods and services that is included in the valuation. The system boundaries of impacts may vary in time, and object that is valued. The object may be chosen anywhere in a cause–effect chain. System boundaries also exist for the population whose values are assessed, and for the emissions and resources used. Other mega impacts have public influence. On the other hand, we discuss how other assumptions relating to future conditions. The cases, where the alternatives mainly differ due to more or less use of fossil fuel is rather insensitive to how the valuation was made with respect to the ranking of alternatives. In cases where there is a trade-off between use of fossil resources and scarce metals, the choice is very sensitive to the temporal system boundary of the impacts and affected population. A database format is proposed for documenting monetary values and related metadata.

**WEPC14**

**Improving transparency, consistency and efficiency of ecotoxicological teaching and learning through development of an online textbook: Environmental Toxicology, Critical Elements (ETCE)**

N. van Straaten, Vrije Universiteit Amsterdam / Department of Ecological Science; T. Hamers, VU Amsterdam University, Institute for Environmental Studies (IVM) / Department of Environment and Health; S. Moe, Vrije Universiteit Amsterdam / UBVU; M. Kraak, University of Amsterdam / IBED-FAME; J. Parsons, University of Amsterdam / IBED-ELD; S. Droge, University of Amsterdam/IBED Institute / IBED; J. Hermens, Utrecht University / Institute for Risk Assessment Sciences; M.G. Vijver, CML Leiden University / Conservation Biology; N. van den Brink, Wageningen University / Dept of Toxicology; A.M. Ragas, Radboud University / Department of Environmental Science; A. Löhr, F. van Bellenheem, Open University

Although several textbooks are available, teaching environmental toxicology in general seems to suffer from a lack of a well-elaborated, up-to-date and consistent textbook that covers all aspects of the field. As a consequence, every university is developing its own training materials in addition to a textbook, but only little of this material is available online. And if materials are online, they are not consistent, lack novelty or do not cover the entire field. A Dutch consortium therefore took the initiative to develop an open online textbook on Environmental Toxicology that should cover the field in its full width, including aspects of environmental chemistry, ecotoxicology, toxicology and risk assessment. The initiative is sponsored by the Netherlands Ministry of Education. The project aims at developing an online open access book on Environmental Toxicology that is useful for training at BSc, MSc and higher levels. The book will be designed in a modular way. Each chapter will have a clear learning goal and a content level and be assigned a number of keywords. The book will also contain tools for self-study and training, like exercises and questions. With the book, we aim at improving quality, continuity and transparency of the education in environmental toxicology. We also want to make sure that fundamental insights on fate and effects of chemicals gained in the past are combined with recent approaches of effect assessment and molecular analysis of mechanisms causing toxicity. To guarantee quality of the book and associated training materials, we aim at having 1-2 authors for each module and also 1-2 reviewers from outside the team of authors. In addition, an advisory board will be involved in supervising the project, as well as educational advisors, while the project team will serve as an editorial board. The project team, consisting of 16 environmental toxicologists and chemists from six Dutch universities, does not possess all expertise to cover the width of the field. We therefore solicit contributions from as many colleagues as possible from within the SETAC community. With that, we hope we can produce a book that is written and supported by SETAC, that is covering the entire field, and is useful for training within e.g. the SETAC Europe Certified Risk Assessor (CRA) programme. The publication as an open online textbook will allow continuous updating of the book, providing a possible role of SETAC in sustaining the book.

**WEPC15**

**Policy learning through professional forums in the field of environmental toxicology: What role for the Society of Environmental Toxicology and Chemistry (SETAC)?**

M. Mondou, McGill University - Macdonald Campus / Dept Natural Resource Sciences; G. Hickey, McGill University - Macdonald Campus / Natural Resource Sciences; S. Maguire, McGill University; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; N. Basu, McGill University / Faculty of Agricultural and Environmental Sciences

Leveraging more than a hundred years of experience and knowledge (Gallo 2008), modern toxicology has crystalized in a set of highly codified and standardized practices that are used by industry and regulatory agencies internationally to assess the risk of chemicals to the environment. Toxicity testing methods using whole animal studies have long provided the general framework of instrumental beliefs concerning the most appropriate way to pursue the goals of environmental toxicology. While such in vivo methods are useful for determining the acceptable levels of single chemicals in the environment, they have a number of limitations that are broadly accepted within the profession. Most significantly, conventional in vivo methodologies are expensive, can take time and can involve large numbers of animals to deliver confidence in the results. Such recognized shortcomings have led to sub-optimal policy outcomes that are increasingly being acknowledged by all stakeholders. For example, the general public and regulatory agencies are being forced to overlook the potential effects of most chemicals in the environment due to a lack of data. On the other hand, the chemical industry is being frustrated by slower access to potentially lucrative markets. Beyond human welfare concerns, the welfare of test animals is also a major consideration, particularly for groups mobilized around the issue of animal rights. Alternative testing methods are being increasingly available, such as using in silico computational models and in...
Thinking green and circularly about microparticles, nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC)

WEPC16
SETAC Science and Risk Communication Interest Group T. Seiler, RWTH Aachen University / Ecosystem Analysis

Biochar-mortar composites for construction materials S. Ott, T. Ses, University of Ulsan / Department of Civil and Environmental Engineering; Y. Sow, University of Ulsan / Civil and Environmental Engineering Feasibility of biochar for construction material was examined through synthesis of biochar-mortar composites and evaluation of their construction and environmental properties according to mixing ratios. Characterization of biochar-mortar composites showed that 3-5% biochar inclusion did not significantly change their flowability, compressive strength, and thermal conductivity. As biochar content increased in biochar-mortar composites, benzene concentration in air was accordingly reduced, suggesting that biochar may be favorable to remove toxic contaminants causing sick building syndrome. Toxicity characteristics leaching procedure (TCLP) and Micotox® bioassay tests showed that biochar-mortar composite were not toxic. Our results suggest that biochar-mortar composites may be promising environmental-friendly materials for building and infrastructure construction area.

WEPC17
Complex Formation Trends of Ligand Binding toward In(III) and Ge(IV) D. Wondrouusch, G. Schuermann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry In recent years, the demand for strategic elements such as Indium and Germanium has increased due to strong global economic growth, especially in the realm of semiconductors. Dwindling resources and growing demand necessitate new recycling strategies and the reassessment of existing repositories in the light of newly developed technologies. In this context, QASR methods can be utilized in the development of selective chelating ligands designed to bind towards essential elements. Through this, novel ligand concepts can be rapidly assessed and synthesis can be prioritized towards promising ligands, resulting in a shortened development cycle and reduced research costs. In our quantum chemical study, we analyze a systematic set of chelators with respect to their complex formation energies toward selected In³⁺ and Ge⁴⁺ complexes. Following a first principles approach, both Density Functional Theory and higher levels of theory have been used for the calculations, also addressing bulk solvation effects. The study focuses on both affinity and selectivity. General trends in binding affinity to selected ions are discussed as related to the electronic structure of the compounds. Chelator selectivity toward In³⁺ and Ge⁴⁺ is investigated in comparison to Fe³⁺, Fe⁴⁺, Cu⁴⁺ and Zn²⁺. The importance of both properties arises from expected high concentrations of these interfering ions relative to the strategic elements of interest. Financial support from the Krüger Research School “Biologically-inspired Catalysis for Sustainable Energy” BHMZ (Nr. 0210205) is gratefully acknowledged.

WEPC19
Cellulose Nanofibers as building blocks for innovative materials for remanufacturing A. Fiorati, INST local unit @ Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta and INST Local Unit; A. Graziano, L. Melone, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grossi, University of Siena / Department of Physical, Earth and Environmental Sciences; N. Pastori, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; C. Punta, Politecnico di Milano From the point of view of circular economy, cellulose is one of the most interesting biopolymer since it derives from renewable sources which, thanks to its peculiar structural properties, it is widely used in the design of simple and advanced materials for different applications. Recently, cellulose nanofibers (CNF) were proven to be versatile building blocks for many preparations. The regioselective oxidation of the C6 primary hydroxyls of the anhydroglucose units, catalysed by TEMPO in the presence of the NaBr/NaClO oxidant system, leads to the formation of TEMPO-oxidized CNF (TOCNF), conferring to the cellulose many interesting properties.1,2 We recently report the synthesis of sponge-like nano-structured materials by cross-linking TOCNF and branched polyethylenimine (bPEI).3 These materials were fully characterized from a chemical, structural and mechanical point of view. Quantitative information on their inner microstructure were collected by Micro-Computed Tomography (μ-CT) analysis.4 In addition the material can be easily modified in order to introduce additional chemical or structural properties. As an example, by functionalizing the bPEI with PdNO₂-phenyl-urea units it is possible to obtain a material that can be employed for the heterogeneous and selective desulphurization of diesel fuels.5 Furthermore, the addition of citric acid (CA) as co-crosslinker enforce the mechanical and structural performances.6 Another application of bPEI-TOCNF sponges is the controlled release of active principles. They have been used it for adsorption and release of two model drugs, amoxicillin and ibuprofen. The material showed very good performances in adsorbing both model drugs (~200 mg / g) from methanol solution. Interestingly, the presence of CA led to slower kinetic release in aqueous environments if compared with materials obtained without CA.4 The ongoing NanoBonD project is focused on the use of these sponge-like materials for soil and water remediation. We have demonstrated that these materials exhibit superb performances in removing contaminants both from fresh and from sea water. In particular we are able to remove heavy metals (Zn²⁺, Cd²⁺, Pb²⁺, Cr⁶⁺ and Cu⁴⁺) and organic contaminants (e.g., β-naphthalene and pentachlorophenol).7 The knowledge regarding the effects on obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (till 100 mg/L), but significant biochemical effects, even at low exposure concentrations. The present study aimed to assess the hazard of Zn-Al LDH in several marine species representing different trophic levels. Exposure tests were carried out with 15 species, including bacterium (Vibrio fischeri), cyanobacterium (Arthrospira maxima), microalgae (Phaeodactylum tricornutum, Tetraselmis chuii and Thalassiosira pseudonana), rotifer (Brachionus plicatilis), bivalves (Cerastoderma edule and Mytilus galloprovincialis), polychaete (Hediste diversicolor), crustaceans (Acartia tonsa, Artemia salina and Palaemon varians) and sea urchin embryos (Paracentrotus lividus). Acute and short-term chronic exposure tests followed standard or well described guidelines, with appropriate adoptions in some cases. Exposure concentrations ranged between 0.01 and 100 mg/L depending on the species tested. The nanomaterial exhibited no toxic effects in most of the tested species, even at the highest exposure concentration. However, adverse sub-lethal effects, such as changes in the enzymatic activity or the physiological endpoints were observed in bivalves and crustaceans. We have shown that the Predicted No Effect Concentration (PNEC) of Zn-Al LDH for seawater was set at 0.2 µg/L, based on the lowest NOEC available (Martins et al. 2017). The results suggest that Zn-Al LDH is a promising engineered nanomaterial featuring a very low environmental hazard.

WEPC21
Studying microfibre release from textiles towards improved clothing design R. Johansson, Helly Hansen; S. Kubowicz, SINTEF Materials and Chemistry; I. Youssef, S.W. Haugen, Helly Hansen; A. Booth, SINTEF Ocean / Environmental Technology Clothing manufactured from synthetic fabrics such as polyester and nylon can release hundreds of microfibres to waste water systems when washed in domestic washing machines. Fibre release has been of particular focus, however, fleece clothing can be made from a wide variety of different fabric constructions, which may exhibit different microfibre release characteristics. Mechanical and chemical finishing of the yarn and fabric will influence the size and
volume of the microfibers released. In the current study, we assess the release of microfibers from different fleece fabrics with the aim of identifying production methods and fabric properties that release the fewest microfibres during domestic washing machines. A filter unit consisting of a 300 µm filter and a 100 µm filter in series was connected to the effluent pipe of a domestic washing machine. Each fleece test fabric (140cm x 90cm) was prepared by overlocking the edges to prevent loss of fibres, washing in a domestic washing machine (1 cycle at 40°C) and then washed with a standard synthetic clothing detergent (1 cycle at 40°C). Weights inside the washing machine assured the same mass for each material assessed and a consistent water flow into the machine. Effluent water was collected in a clean container and a sub-sample (1 L) passed through a 20 µm filter to collect any microfibres that pass through the filter unit. Each test fabric was first washed to study release in new clothes, and then washed a second time to determine release due to shedding. To improve the accuracy of the results, the two washing procedures were repeated in triplicate. A rinse cycle was run between each test wash to ensure removal of any remaining microfibres from the system. The hoses connecting the filters contained residual microfibres after washing; these were collected after each wash by cleaning the hoses manually. The pre-weighed filters were allowed to dry before the mass of fibres was determined. The number of fibres was then estimated based on microscopy counting of a pre-weighed sub-sample of the microfibres. Preliminary results show that ~80-90% of fibres in the effluent water are trapped by the 300 µm filter. Furthermore, the fibre release declines with successive washings. A detailed study of the underlying mechanisms is currently ongoing and the results will be used as a basis for ranking.

WEPC23 Environmental Footprint for pasta production - the PEF pasta pilot J. Ruim, Barilla G.E.R. Fratelli Societa per Azioni; L. Laurena, UN.A.F.P.A.; L. Marchelli, Barilla G. & R. Fratelli; P. Borla, Life Cycle Engineering UN-A.F.P.A., representing all the European pasta manufacturers, is the main proponent of the EU pilot on PEF for pasta production. Furthermore, Italian companies of pasta producers (Barilla, Pasta Zara and Garofalo) decided to be directly part of the Technical Secretariat. The proponents of the pilot for pasta together represent about the 30% of the total production of pasta in the European Union. The PEF pilot, while encouraging the development of sustainable production all over the supply chain from farm to fork, enhances fair competition across different product categories. In this package, the PEF is used to ensure: a) the maximum clarity in order to increase the suitability and robustness of the LCA implemented in the PEF method for pasta sector. The main difficulties noticed during the pasta pilot were about the hotspots management, when the producers do not directly manage those processes.

WEPC25 Life Cycle Assessment of applying Algal Oil in salmon aquaculture; challenges for methodology and tool development H. Bosch, DSM Nutritional Products; A. Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH; F. Ziegler, RISE Research Institutes of Sweden Evonik DSM founded the joint venture Veramaris®, introducing a new Algal Oil based omega-3 fatty acid source for aquaculture. This intracellular oil is produced in a biotechnological manufacturing process using non-marine resources. The rationale for this development is that the capacity to generate omega-3 fatty acids through fish is not sufficient to fulfill the dietary requirements of a growing population, and that many fish species used as feed in aquaculture are either fully utilized or overfished, leading to a lack of room for expansion. Algal Oil reduces the dependency of salmon aquaculture on marine fatty acid production and fish stocks, by replacing marine ingredients with algal oil and crop-based ingredients. To illustrate the environmental impacts and potential tradeoffs of this new product, a Life Cycle Assessment (LCA) was performed. Indicators developed for application of LCA to fisheries were used in an LCA to assess the marine ecosystem impact of replacing fish meal and fish oil by Algal Oil in salmon feed. The analysis had to be performed in a separate calculation outside the LCA software, because the software does not include the required data and methods. The study demonstrated that the use of Algal Oil as a source of omega-3 fatty acids leads to a considerable reduction of impact on marine ecosystems of farmed salmon. This improvement is accompanied by an increase in impacts associated with agriculture. Current LCA methodologies do not allow weighting of these opposing effects. However, to make informed choices between the available options this would be required. Because the availability of natural marine resources is limited, the strong growth expected in salmon aquaculture requires innovative feed solutions decoupled from limited fish stocks to meet future requirements for omega-3 fatty acids. Veramaris® Algal Oil in combination with vegetable crops enables growth of salmon aquaculture that is independent of limited fish stocks. To support the choices discussed in this presentation, and similar choices, implementation of fishery impact assessment methods in LCA tools and development of weighting methodology is essential. Just as for other biotic impacts, there are also challenges of non-linearity and temporal and spatial variability connected to fishery-specific impacts, which are of a more local nature than global-scale life cycle impacts.

WEPC26 Balancing Environmental and Health Impacts of Food Production and Consumption C. Walker, Institute of Environmental Engineering, ETH Zurich; S. Hellweg, ETH Zurich / Institute of Environmental Engineering An individual’s food choices can affect not only the magnitude of their food-related environmental footprint, but can also have a direct effect on their personal health. People consuming lower amounts of meat tend to have lower environmental impacts, but it has also been found that they also tend to have lower risk of certain diseases. However, on the other hand, people with low vegetable or fruit consumption may also have relatively lower environmental impacts, while having increased risk of disease. This study investigates the daily eating patterns of a European population sample to identify and compare each individual’s environmental impacts due to their food production as well as the health impacts that can be expected due to their food consumption patterns. The Global Burden of Disease has identified dietary risk factors that have been shown to contribute to incidence of cardiovascular disease (CVD). Results show that for individuals under-consuming whole grains (less than 125 grams daily), for every 1 micro disability adjusted life year (µDALY) increase in production impacts, there is a health benefit of 141 µDALYS. Similar results were found for all...
dietary risk categories in which under-consumption of a particular food group was considered a dietary risk. In cases where overconsumption poses a health risk, as is the case in certain meats, sodium, and sugar sweetened beverages, a 1 µDALY increase in production impacts is associated with increases in health impacts to varying degrees, ranging from 1.2 µDALYs for red meat up to 36.8 µDALYs for sugar sweetened beverages. This study found that for most of the dietary risk categories, health impacts due to consumption far outweighed the environmental impacts (measured in terms of µDALYs), however this study did not include environmental impacts as they are related to other impact categories such as ecosystem damage and resource depletion, which must also be considered to fully capture food production impacts.

WEP27
What not to waste? Improving decision support for Food Loss and Waste (FLW) mitigation by considering food security and environmental sustainability
F. Sessa, Quantis; M. Ruth, World Business Council for Sustainability Development (WBCSD); D. Pollard, Nestlé; K. Cooper, A. Cairns, World Business Council for Sustainability Development (WBCSD); X. Bengoa, S. Humbert, M. Vargas Gonzalez, A. Ermstoff, Quantis
LCA-based methods provide evidence of the largescale environmental impacts of food production. Nearly a third of food produced is lost or wasted, meaning production impacts occur with little to no societal service. The primary focus of response e.g. the UN SDG 12.3 has been on avoiding food loss and waste (FLW) quantification, for example halfing food waste by 2030. Decision-makers, thus may prioritize FLW mitigation based on quantity, economica gain, and ease of implementation. To support multi-criteria sustainability decision-making we develop a framework and perform a global screening to prioritize FLW mitigation efforts based on two material issues: environmental impacts and nutrition security. LCA-based methods quantify environmental impacts related to FLW streams, and nutrition and global burden of disease data are used to quantify nutrition security. A global screening of FAO data on food production, supply, and FLW for various food categories (e.g. grains) is performed in 15 countries. Results demonstrate vastly different environmental impacts and nutrition security potential associated with various FLW streams. The results suggest that there is sufficient production of most nutrients globally, suggesting that in most cases food systems do not need to grow, but need to be optimized to reduce FLW and offer appropriate regional supply.

WEP28
ARIADNA Project. Analysing the sustainability of implementing a mandatory Deposit-Refund System in Spain
A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change. Escola Superior de Comerç Internacional ESCI; P. Fullana, B. Díaz, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; R. Colomé, Universitat Pompeu Fabra UPF / Escola Superior de Comerç Internacional; J. Ribas, Universitat Pompeu Fabra UPF; S. Ayuso, Universitat Pompeu Fabra UPF / MANGO Chair in Corporative Social Responsibility; I. Muñoz, 2.0 LCA consultants; B.P. Weidema, Aalborg University / Department of Planning
There is currently an ongoing debate in some Spanish regions on whether the implementation of a mandatory deposit-refund system (DRS hereafter) would be appropriate. A DRS can be simply defined as a system in which consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. This is a system in place in some European Countries such as Germany, Finland or Denmark whereas others such as France or the UK have refused its implementation. From a regulatory point of view, the Spanish Law 22/2011 (which transposes the correspondent European Directive 2008/98/CE), clearly states that the implementation of a DRS should be based on the analysis of its technical and economic feasibility, a set of environmental, social and human health impacts and must ensure the proper functioning of the internal market. The study presented here follows this regulatory framework, analysing the sustainability of implementing this new system, combining environmental, economic and social studies in order to get an holistic picture of its feasibility. In particular, the following methodologies were used: (1) Life Cycle Assessment (LCA) for the environmental study; (2) Classic Cost Accounting for the economic study and (3) Social Footprint and Quantification of the Integrated Social Value for the social study. All of them applied using the same data, system boundaries and modelling restrictions. The study clearly concludes that the introduction of a DRS in Spain, under the studied conditions, is not advisable. This is because: a) according to several environmental indicators, although it could achieve an improvement in the overall recycling rate, it carries a higher environmental impact, mainly due to the duplication of collecting systems and the increase demand in transportation; b) represents a 4.6-fold increase in the economic cost to society (11 times if we only consider the management of DRS containers); and c) from a stakeholders’ point of view, it will have a significant increase both in space and time needs, and it will cause a higher Social Footprint.
Accumulation.

Aquatic toxicity.

Ammonia.

Adsorption.

Behavior.

Biotransformation.

Biomonitoring.

Biodegradation.
7,TU244,TU253,TU255,TU277,TU289,TU418,
TUPC21,WE006,WE046,WE059,WE061,WE0
65,WE149,WE293,WE400
Case study.
144,149,16,189,193,209,217,224,255,259,261,2
64,284,285,304,311,320,327,353,363,427,437,4
4,442,514,551,556,564,579,601,611,622,624,62
6,634,635,638,654,668,69,73,94,MO012,MO01
4,MO038,MO052,MO066,MO074,MO087,MO
094,MO095,MO109,MO152,MO194,MO287,M
O332,MO342,MO355,MO358,MO376,MO378,
MO390,MO434,MO438,MOPC01,TH052,TH0
62,TH078,TH081,TH171,TH196,TH227,TH22
8,TH229,TH236,TH288,TH304,TH306,TH312,
TH313,TH315,TU028,TU048,TU083,TU093,T
U097,TU102,TU160,TU163,TU203,TU210,TU
215,TU216,TU219,TU220,TU221,TU222,TU2
23,TU224,TU228,TU235,TU237,TU238,TU24
8,TU250,TU251,TU284,TU344,TU346,TU347,
TU368,TU381,TU391,TU393,TU402,TU412,T
U414,TU422,TUPC07,WE026,WE040,WE042,
WE088,WE099,WE198,WE199,WE225,WE23
8,WE262,WE274,WE277,WE338,WE341,WE3
62,WE415,WE425,WEPC10,WEPC11,WEPC1
2,WEPC25,WEPC28
Chemical signalling.
290,531,593,TH074,TU018,TU069,TU176,TU1
77,TU192,WE029,WE125,WE130,WE415,WE
421
Chronic toxicity.
153,169,216,324,37,39,495,497,531,559,662,M
O017,MO047,MO076,MO086,MO164,MO166,
MO186,MO230,MO239,MO245,MO268,MO29
1,MO297,MO327,MO328,MO357,MO369,MO
395,MO417,MO454,TH012,TH053,TH068,TH
078,TH134,TH149,TH183,TH191,TH204,TH2
20,TH224,TH280,TH284,TH289,TH319,TU02
5,TU038,TU063,TU077,TU079,TU110,TU114,
TU115,TU118,TU120,TU130,TU140,TU144,T
U181,TU182,TU188,TU329,TU332,TU352,TU
376,TU424,TU428,WE008,WE009,WE014,WE
079,WE082,WE102,WE105,WE110,WE142,W
E143,WE289,WE291,WE312,WE324,WE331,
WE351,WE356,WE357,WE377,WE380,WE38
2,WE388,WE391,WE407,WE408,WE420,WEP
C02
Climate.
167,196,228,234,275,310,315,348,366,367,376,
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